Illinois U Library

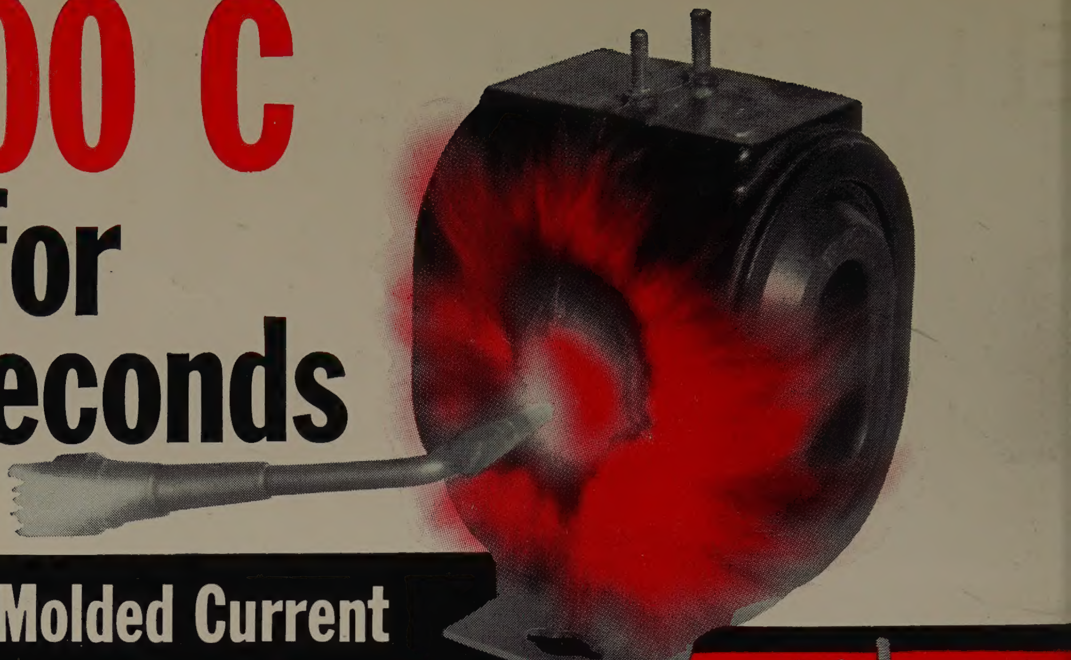
ELECTRICAL ENGINEERING

SEPTEMBER

1954

MIDDLE EASTERN DISTRICT MEETING, READING, PA, OCTOBER 5-7, 1954

3500 C for 30 Seconds



This Molded Current Transformer Meets Fire Test

Allis-Chalmers thru-type molded current transformers can cause no fire hazard. Recent tests prove they will not support combustion or add to the intensity of a fire — an important thing to look for in a current transformer.

Hold More Conductors

Allis-Chalmers thru-type molded resin transformers hold more conductors than any other thru-type current transformer of corresponding rating now on the market. The oval window is large enough to hold two 500 MCM stranded conductors for any current rating in the 600-volt insulation class.

High Metering Accuracy

These transformers provide accuracy with the burden of one or more watthour meters. They are manufactured in four primary current ratings, with intermediate ratings available by passing the primary conductor through the window two or more times. Installation is simple and maintenance has been completely eliminated — no painting is required. Get complete facts from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 61B8080. A-4385

ALLIS-CHALMERS Instrument Transformers

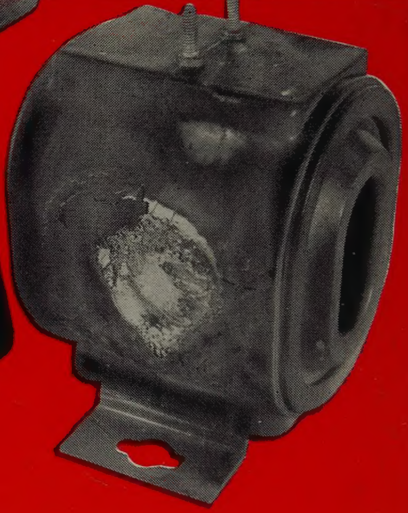
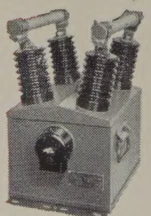


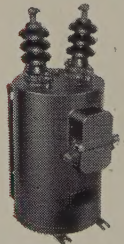
Photo shows Type TWM current transformer after application of 3500 C for 30 seconds. The resin extinguished itself completely. Charring occurred to depth of 3/16 inch, but beneath this depth the resin was still solid.

ALLIS-CHALMERS

Outdoor current transformers, Type KO, rated up to 15 kv and 1800 amp.



Indoor potential transformers, Type PD, rated up to 14,400 volts, 200 va, fused or unfused.



Outdoor potential transformers, Type PWD, rated up to 15 kv, 200 va.

Over 400 Types and Ratings

ELECTRICAL ENGINEERING

Registered United States Patent Office

The Cover: The electrically operated shovel on the cover is connected to its substation by a 2,000-foot cable. Two 1,250-hp synchronous motors drive four 375-kw d-c generators, which operate at 250 volts and drive four 425-hp motors for hoist and dragline. A 500-hp induction motor drives three 112.5-kw d-c generators, which drive three 125-hp swing motors. A 350-kva transformer steps down the voltage from 4,160 to 240 and 480 volts as auxiliary supply for driving about 25 motors totaling 100 hp for pumps, fans, compressors, etc. An operator and an oiler can operate the shovel, using a Ward Leonard control.

SEPTEMBER
1954

What Is Your Opinion? II . . . 789

The Goals of University Research . . . L. A. DuBridge . . . 790

Pleasures of Development Engineering . . . P. A. Abetti . . . 793

Ten Founding Fathers of Electrical Science—VI . . . Bern Dibner . . . 796

Differential Phase and Gain Measurements in Color Television Systems . . . H. P. Kelly . . . 799

What Is Ferrimagnetism? . . . L. R. Maxwell . . . 804

New Electric Device to Detect Leaks of Inflammable Gases . . . W. C. White . . . 806

Effect of Electric Discharges on the Breakdown of Solid Insulation . . . T. W. Dakin, H. M. Philofsky, W. C. Divens . . . 812

TECHNICAL PAPER DIGESTS

Speed-Torque Calculations for Induction Motors . . . P. L. Alger, Y. H. Ku, C. H. T. Pan . . . 795

Controls for Operating Steam Turbine Generators . . . O. N. Bryant, C. C. Sterrett, D. M. Sauter . . . 798

Methods for Determining Primary Feed Points . . . D. L. Hopkins, D. R. Samson . . . 803

H-V Impulse Tests on Lines and Substations . . J. W. Skooglund, W. H. Kolb, T. L. Dyer, Jr. . . . 809

Computer Search for Operating a Hydro System . . . R. J. Cypser . . . 810

Energy Storage Methods for Two Hydro Plants . . . B. V. Hoard . . . 811

X-Ray Absorption Analysis of Treated Carbon . . . A. C. Titus . . . 818

MISCELLANEOUS SHORT ITEM: Electronic Cage Heater, 817

Institute Activities . . . 819

AIEE Personalities, 831; Obituaries, 832; Membership, 833

AIEE Officers and Committees for 1954–55 . . . 834

Of Current Interest . . . 861

Industrial Notes . . . 18A

New Products, 18A; Trade Literature, 42A

Index to Advertisers . . . 84A

Charles S. Rich
Editor

G. C. Baxter Rowe
Associate Editor

F. A. Norris
Business Manager

. S. Lopes
Advertising Director

Editorial Assistants

D. M. Anderson
D. L. Kyte
E. M. Tucker
D. S. Viebig

Statements and opinions given in articles appearing in ELECTRICAL ENGINEERING are expressions of contributors, for which the Institute assumes no responsibility. Correspondence is invited on controversial matters.

Published monthly by the

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Founded 1884

Headquarters
33 West 39th Street
New York 18, N. Y.

Editorial Offices
500 Fifth Avenue
New York 36, N. Y.

A. C. MONTEITH, President

N. S. HIBSHMAN, Secretary

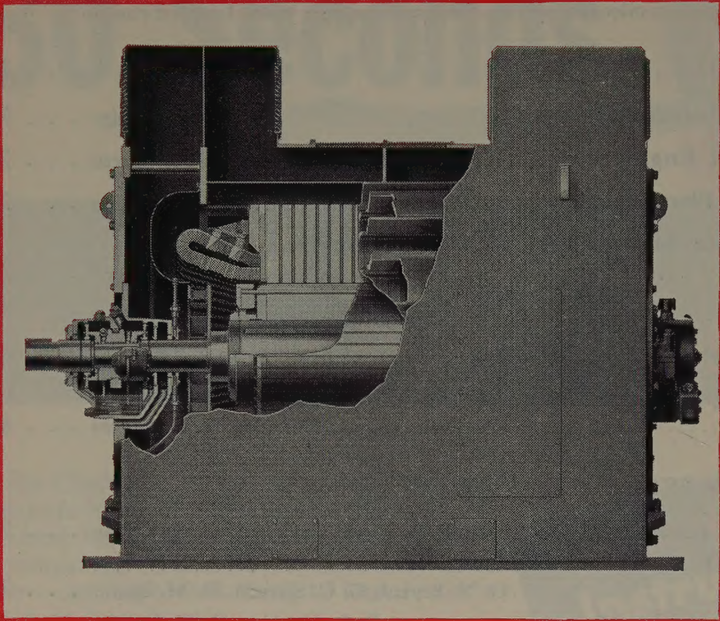
PUBLICATION COMMITTEE: M. D. Hooven, *Chairman* E. W. Boehne J. G. Brainerd D. T. Braymer J. L. Callahan H. W. Codding C. E. Dean W. F. Denkhaus E. T. B. Gross M. F. Kent R. E. Kistler M. G. Malti G. R. Mezger H. N. Muller, Jr. C. S. Rich Victor Siegfried J. D. Tebo

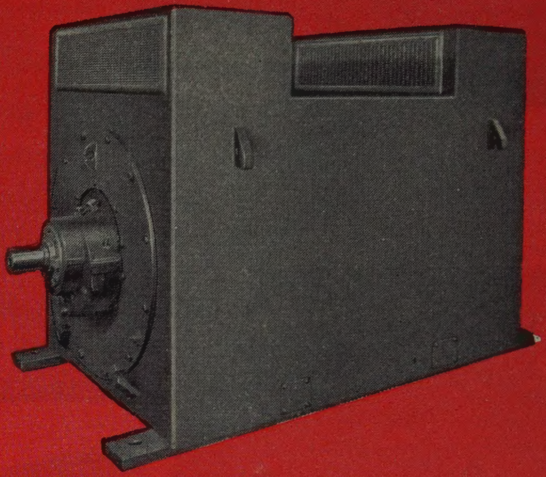
VOL. 73 NO. 9

ELECTRICAL ENGINEERING: Copyright 1954 by the American Institute of Electrical Engineers; printed in the United States of America; indexed annually by the AIEE, weekly and annually by *Engineering Index*, and monthly by *Industrial Arts Index;* abstracted monthly by *Science Abstracts* (London). Address changes must be received at AIEE headquarters, 33 West 39th Street, New York 18, N. Y., by the first of the month to be effective with the succeeding issue. Copies undelivered because of incorrect address cannot be replaced without charge.

Redesigned

INSIDE AND OUT





ALLIS-CHALMERS
Boiler-Feed Pump
MOTORS

New features improve 2-pole motors long known for reliability and low maintenance.

New ventilating arrangement features top air intake and discharge *plus* spiral stator core ventilation. Top intakes (available with filters) keep motor clean and make motor room cleaning easy; top discharge adds to personnel comfort. Spiral ventilation — used in turbine generators — assures even internal cooling . . . combines with centrifugal fans and baffled air passages to reduce noise.

Improved bearing design simplifies maintenance, prevents oil leakage. Capsule-type housings — proved in use on other designs — permit inspection of windings without exposing bearings. Oil leakage is prevented by a combination of features, including orifice-metered oil flow, weirs to maintain correct oil level, labyrinth seals, breathers, and annular pressure chambers with atmospheric relief.

Clean-cut appearance is gained by providing internal space for stator and auxiliary leads, etc.

Features that helped build the Allis-Chalmers 2-pole motor reputation for reliability are retained in the new design. These include proven stator coil design, ample stator coil end bracing, thermally and mechanically stable cage assembly, separate balancing rings, and oxygen-free dew-drop cage bars.

This design available in ratings 900 hp and larger. Ask your A-C representative for Bulletin 05R8123. Allis-Chalmers, Milwaukee 1, Wisconsin. A-4350

ALLIS-CHALMERS

HIGHLIGHTS........

New Prize Rules for AIEE Papers. A revision of the rules for the award of prizes for AIEE papers was approved by the Board of Directors in June, and became effective on August 1. Prizes are available each year for AIEE papers in the following categories: Institute, District, Section, and Student Branch (*pp. 825–6*).

Future Meetings. As always, the active fall season brings a number of meetings of interest to AIEE members. In September is the first AIEE Conference of the Petroleum Industry which will be held in Tulsa, Okla. Some 19 papers will cover electrical applications in oil and gas production, refining, transportation, and allied petro-chemical fields (*pp. 826–7*). Early October will see the AIEE Middle Eastern District Meeting in Reading, Pa., and the tenth National Electronics Conference in Chicago. The Middle Eastern Meeting will include a full program of technical sessions, social events, and inspection trips (*pp. 819–22*). The National Electronics Conference, of which the Institute is a cosponsor, will supplement an 88-paper program with more than 160 exhibits by electronics manufacturers (*pp. 823–4*). The Fall General Meeting of the Institute also will be held in Chicago in October. The 50th anniversary of Eta KapJa Nu will be celebrated at this time on the campus of the University of Illinois (*pp. 828–9*). Another October meeting will be the Machine Tool Conference which will meet in Detroit, Mich. (*pp. 830–1*).

Employment Conditions Questionnaire. The membership is again reminded in this issue of the questionnaire on employment conditions which will be distributed by the AIEE about the middle of September. The questionnaire seeks to determine the opinions of the members relative to various methods of communication between engineers and their employers on the broad subject of employment conditions (*p. 789*).

News Index

Institute Activities....................819

Middle Eastern District Meeting..............819
Future AIEE Meetings........................819
Board of Directors Meets....................822
National Electronics Conference.............823
New Prize Rules for Papers..................825
First Petroleum Industry Conference.........826
Fall General Meeting........................828
AIEE Personalities..........................831
Obituaries..................................832
Membership..................................833

Of Current Interest....................861

Silencer for Ground Operations of Jets......861
Future Meetings of Other Societies..........861

Officers and Committees. With the beginning of a new Institute year, a complete listing of AIEE officers, committee and subcommittee personnel, and representatives for 1954–55 is presented in this issue. Also included are the latest listings of Sections, Subsections, and Student Branches (*pp. 834–60*).

Pleasures of Development Engineering. The Eta Kappa Nu Award to the Outstanding Young Electrical Engineer of 1953 went to Dr. P. A. Abetti who is a development engineer with the General Electric Company. In his address at the award dinner, Dr. Abetti discussed the pleasures of his work—of developing things, of developing people, and of developing oneself (*pp. 793–4*).

Ten Founding Fathers of the Electrical Science—VI. Through his investigations and experiments, Georg Simon Ohm established the law determining the flow of an electric current in a conductor and thought of the current and resistance much in the same sense as today. Ohm's law has become the basis of determination of all electric circuits. His theories and experiments are described (*pp. 796–7*).

New Electric Device to Detect Leaks of Inflammable Gases. With existing equipment it is possible to detect the presence of dangerous gases in a closed space. By employing this new detector element in such equipment the location of a leak in pipes, fittings, or tanks can be exactly determined, as described (*pp. 806–08*).

The Goals of University Research. The university is seen as a place which should be dedicated to helping mankind know more. The mechanism for accomplishing this goal is research. Thus university research should enlarge man's understanding of the world, his fellow men, and himself. Certain types of research considered unsuitable for universities are discussed, but it is held that there is no conflict between teaching and research (*pp. 790–3*).

Differential Phase and Gain Measurements in Color Television Systems. A test set to measure differential phase and gain is described. Its transmitter and receiver are both provided with a self-contained power supply operated from 115-volt 60-cycle power. The measurement is presented as a display on an oscilloscope. Scales of 0.5 db per inch differential gain and 2.5 degrees per inch differential phase are obtainable (*pp. 799–802*).

Bimonthly Publications

The bimonthly publications, *Communication and Electronics*, *Applications and Industry*, and *Power Apparatus and Systems*, contain the formally reviewed and approved numbered papers presented at General and District meetings and conferences. The publications are on an annual subscription basis. In consideration of payment of dues, members (exclusive of Student members) may receive one of the three publications; additional publications are offered to members at an annual subscription price of $2.50 each. The publications also are available to Student members at the annual subscription rate of $2.50 each. Nonmembers may subscribe on an advance annual subscription basis of $5.00 each (plus 50 cents for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.00 each. Discounts are allowed to libraries, publishers, and subscription agencies.

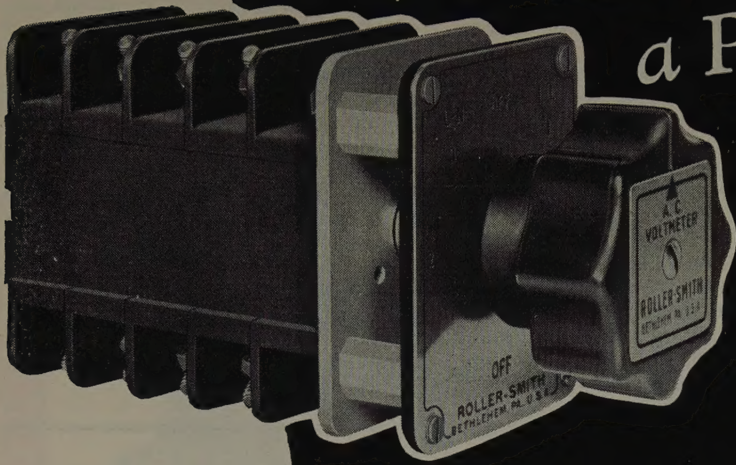
What Is Ferrimagnetism? The basic concept of ferrimagnetism requires the existence, within a given domain, of two mutually opposing systems of magnetic ions. The elements of ferrimagnetism are examined and the present types of magnetic states—ferromagnetism, paramagnetism, ferrimagnetism, and antiferromagnetism—and their relationships to each other are summarized. Studies of ferrimagnetism may be instrumental in obtaining a ferrite which is ferromagnetic (*pp. 804–06*).

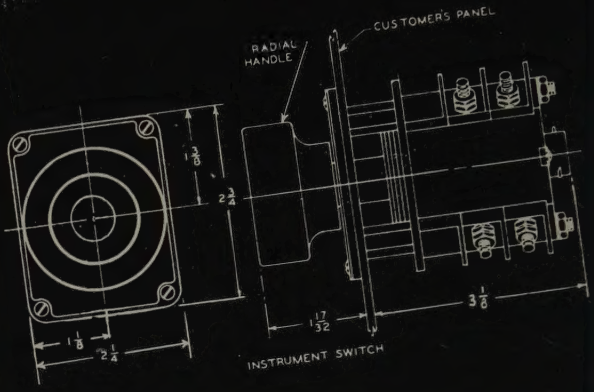
Effect of Electric Discharges on the Breakdown of Solid Insulation. The effect of corona on the long-time dielectric strength of insulation is emphasized. The various factors influencing the breakdown of insulation with corona are discussed. Data on the corona threshold voltages on dielectric surfaces at electrode edges show that the threshold voltage varies for a wide variety of dielectrics only as the ratio of dielectric thickness to dielectric constant (*pp. 812–17*).

Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. N. S. Hibshman, Secretary, 33 West 39th Street, New York 18, N. Y.

ELECTRICAL ENGINEERING. Published monthly by the American Institute of Electrical Engineers; publication office 20th & Northampton Streets, Easton, Pa. Editorial and advertising offices 500 Fifth Avenue, New York 36, N. Y. Subscription $12 per year plus extra postage charge to all countries to which the second-class postage rate does not apply; single copy $1.50. Entered as second-class matter at the Post Office, Easton, Pa., under the Act of Congress of March 3, 1879. Accepted for mailing at special postage rates provided for in Section 538, P. L. & R. Act of February 28, 1925. September 1954, Vol. 73, No. 9. Number of copies of this issue 57,200.

Where Panel Space is at a PREMIUM . . .

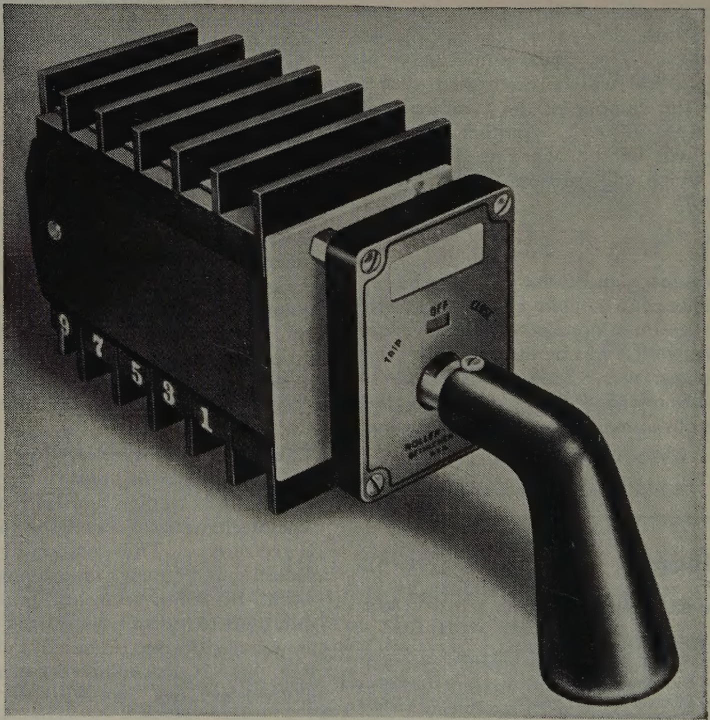




use the R-4 Miniature Rotary Switch

Illustrated above is the R-4 Miniature Rotary Switch—available now for those applications where space is at a premium. Featuring unit construction, silver contacts, 600 volt insulation, enclosed mechanism and choice of handles, the R-4 provides the same high interrupting capacity, long life and flexibility found in the standard R-2 Control switch illustrated at right.

Both R-2 and R-4 Rotary switches are available in a wide combination of contact arrangements for Instrument—Control—Transfer—Auxiliary and Special Applications.



Catalog 7140 contains complete information. Request your copy today. For a prompt answer to your switch problem—consult the Factory or your nearest Roller-Smith Sales office.

Instrument Division

ROLLER-SMITH CORPORATION
1825 WEST MARKET STREET
BETHLEHEM, PENNSYLVANIA

Since 1908—producers of high quality electrical instruments, aircraft meters, rotary switches, relays and precision balances.

What Is Your Opinion? II

THE August issue of *Electricial Engineering* carried on this page the announcement of a questionnaire on employment conditions to be sent to AIEE members in continental United States about the middle of September 1954. If you were on vacation when the August issue came, your Board of Directors urges you now to read that announcement and its explanation of the project, and to resolve to give the questionnaire your thoughtful and prompt attention when it arrives in your mail. The subject of the questionnaire is one of the most important problems now before the engineering profession. It deals with the relation of the engineer as an employee to his employer. Your Board of Directors asked the Committee on Planning and Co-ordination to prepare this questionnaire, test it for clarity, and send it to all the members concerned, so that the answers might be in and available for the Board's guidance this fall. Before answering questions, there may be a few that you would like to ask; such as: "Who wants to know?"; "Why do they want to know it?"; and "Why can't they find out without another of these questionnaires?"

WHO WANTS TO KNOW?

FIRST of all, your Board of Directors, charged with the management of your Institute, needs facts and opinions that only you can give; so that they may discharge the responsibility of representing you. It may be worth while to recall who the Board of Directors are and how they came to represent you. First, there are the ten District Vice-Presidents chosen directly by your Section chairmen and other representatives on the District Executive Committee. Then there are 12 Directors, the President, Treasurer, and two past presidents. These 16 were selected as candidates for office by a Nominating Committee of 20 members. Ten were selected by the Section chairmen and Section delegates in the District Executive Committees. Five were selected by the technical divisions, and five by the current Board of Directors. After this Nominating Committee has offered its candidates, any 25 members of the Institute, representing nobody but themselves, can place other names on the ballot by simple petition.

For the Board taking office August 1, 1954, the ballot carried only the Nominating Committee's candidates. There was no contest. Yet 15,435 members voted; simply to express their approval of the candidates and their confidence in the representative processes of the Institute. Only 36 used the ballots to express dissatisfaction.

The point of all this is: your officers and Directors have good reason to believe that you take your membership in the Institute seriously; and that they in turn must take their responsibility as your representatives very seriously. The Board now feels that it needs up-to-date facts about you, your wishes and opinions, to discharge this responsibility.

The other major engineering societies such as the ASCE, ASME, the AIME, and the AIChE work together with AIEE in Engineers Joint Council (EJC), and in Engineers' Council for Professional Development (ECPD), and are now engaged with AIEE in an effort to build a great new engineering center building. If a unified profession is ever achieved, it will probably be through the co-operative efforts of these five societies working with the other smaller bodies in EJC and ECPD and with the National Society of Professional Engineers (NSPE). ASCE and ASME have already canvassed their membership with questionnaires similar to the one coming to you. Other societies including NSPE have obtained or will obtain samplings of their member opinion. It is fair to say that the whole profession wants to know where it stands in this matter.

WHY DO THEY WANT TO KNOW?

ONE reason is that the employment conditions under which engineers work have been or may become a matter of law. If those who make and change the laws are to know what engineers think and want, engineers must tell them. Another reason is that we as employers and employees need to know more about ourselves if we are to work out our problems in a manner befitting a profession noted for problem solving.

WHY A QUESTIONNAIRE?

QUESTIONNAIRES have become something of a nuisance. They are expensive too. Is there no easier, less expensive way that AIEE can carry on the dependable, quick, and satisfactory 2-way communications that must exist between the members and the Board of Directors if the Institute is to function with its greatest effectiveness? We now have a number of channels of communication. Perhaps they could be used more effectively.

Our monthly magazine *Electrical Engineering* is written by the members for the members. It carries full reports of all the Board meetings and the "Annual Report of the Board of Directors." It prints news of Institute affairs and it has a column for "Letters to the Editor."

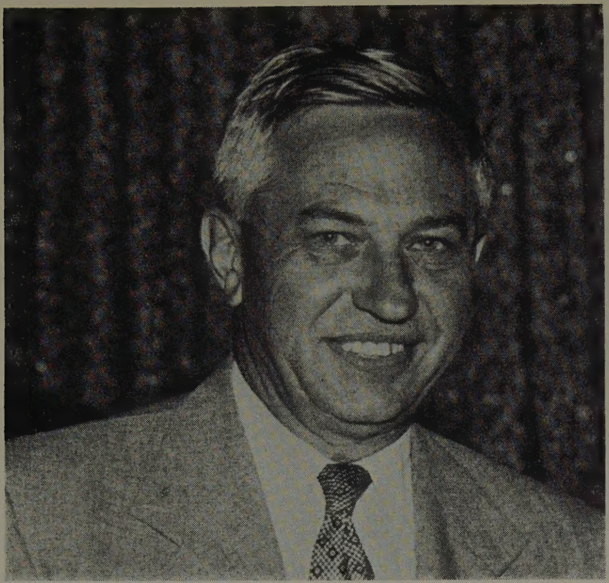
The President used to visit the Sections when there were not so many as to make that impossible. Now the Vice-Presidents perform this function in their Districts. If you do not like to write letters to the editor, you can always write to your President or Vice-President or to the Board as a whole through the Secretary.

The Section Delegates Conference at the annual Summer General Meeting is an effective means of communication between the Board and the Sections.

The Yearbook is a valuable source of information and in its compilation pertinent facts become available.

The Publications Survey of 1952 led to the very popular bimonthly *Transactions.*

All of these channels of communication are valuable, depending on the extent to which they are used. However, your Board of Directors feels that, in a matter such as employment conditions, there can be no substitute for asking each member his own, individual, personal opinion. Then, if there is legislation to be supported or opposed, or other important issues to be faced, your representatives know where to stand, because they know where you stand.



The Goals of University Research

L. A. DuBridge

The university is viewed as an institution for sharpening men's intellectual abilities and focusing them on mankind's basic problems. Research seeks knowledge as a step toward understanding.

As the title suggests, I am not proposing today to argue about the desirability or importance of research, about its cost, or about the shortage of research people or research funds. All these things can be taken for granted here.

But I am going to take the liberty of reflecting for a few moments on another subject, which possibly should also be taken for granted; namely, the place of educational institutions in the advance of science and technology.

Clearly, in order that my remarks on this subject should make sense, I must explain what kind of an educational institution I am talking about and I must state my own philosophy of what such institutions should be.

Obviously, I am not going to be talking about either public or private elementary or high schools, or even junior colleges. Nor shall I try to encompass the problems of the separate liberal arts college. In fact, in order that I may stay within an area which has relevance to the interests of this audience, I shall speak only of such institutions of higher education which are commonly called universities.

I must admit that I have a highly prejudiced, almost emotional, feeling about universities. I happen to think that they are about the most important institutions in the Western World. I believe they have made contributions to western civilization—physical, intellectual, and spiritual contributions—which are beyond the power of any man to compute or to comprehend. And I believe that the nature of the civilization that our grandchildren will inherit on this earth will depend in a critical, possibly in a decisive, degree on what our universities do, or fail to do, in coming years.

I believe in this decisive role of the university, not because I deprecate the role of our other educational, religious, and political institutions, but I believe that the way in which civilization changes over the centuries is largely determined by how men use their heads. The university, as I view it, is the spearhead of man's efforts to make better use of what is in his head. It is at the university that men's intellectual abilities are sharpened and are brought to focus on mankind's basic problems. At the university, man's intellectual forces are mobilized for the attack on those great unknowns which lie just beyond the frontiers of knowledge. It is the role and the task of the university to be eternally dissatisfied—dissatisfied with man's inadequate knowledge; dissatisfied with the ways in which he uses his knowledge. Thus, the chief aim of a university must be, not merely to help individual men to learn more, but to help mankind to know more.

And that is about as succinct a way as I know of expressing the goal of a university: to help mankind to know more. In seeking this goal, the specific mechanism available to the university is called research. The purpose of university research then is to enlarge man's understanding of the world, his understanding of his fellow men and of himself.

You will note that I have used interchangeably the phrases, "to know more" and "to understand more." I do this without apology—and, in fact, with emphasis. To know and to understand are not quite synonymous. For, though one normally cannot understand without knowing, we frequently know things we do not understand. Yet the goal of research must be not merely to acquire knowledge for its own sake, but to secure knowledge as a step toward understanding. A research project collects facts—experimental data—not solely to prepare tables of numbers, but as an aid to finding or perfecting a theory, an interpretation, an understanding of the phenomenon. Furthermore, in science we must be most exacting in judging how far understanding has been achieved. In science we require that understanding shall be quantitative, not merely qualitative, and that it lead to the ability to predict. We require that our theory explain all the related facts, not just some of them, that it describe accurately in advance all experiments which we perform. We also aim for theories which have simplicity, elegance, beauty. Reaching an understanding of things not only satisfies an intellectual desire, but an emotional or aesthetic one too.

To repeat, then, the goal of a university is to help man

Revised text of an address presented before the AIEE Summer and Pacific General Meeting, Los Angeles, Calif., June 21–25, 1954.

L. A. DuBridge is president of the California Institute of Technology, Pasadena, Calif.

learn more and to help man understand more. Research in science, technology, and other fields is essential to the fulfillment of the university's mission. However, it is also obvious that the research undertaken must be devoted solely to achieving that mission—achieving understanding.

This is the reason why the research in a university—whether it be in science or in engineering—must, above all else, stick to fundamentals. No one questions, of course, that the job of the scientist is to do "basic" or "fundamental" research. But it is too often assumed that the job of the engineer is to avoid fundamentals and to invent gadgets. This is, of course, nonsense. The engineer in a university has just as much obligation to stick to the fundamentals in his field as the chemist or physicist in his. The university civil engineer is not concerned with designing just another bridge or dam, but with developing new practices, new principles, new materials, new methods of structural design. The mechanical engineer does not simply invent an improved governor for a steam engine; he tries to advance understanding of thermodynamics, of solid and fluid mechanics, of the structure of matter, the nature of vibrations, of fatigue, etc. I need not tell this audience the job of the electrical engineer.

The university engineer is thus in an extremely critical position, intermediate between the pure scientist on the one hand and the industrial designer or inventor on the other. To some extent he does the things which the industrial engineer thinks the scientist ought to do—but in which the scientist has lost interest. The physicist is engrossed in the problems of nuclear forces; who is going to develop the fundamentals of nuclear technology? It's a long step from Fermi's first chain reaction to the first economical power plant with a great deal of room in between for fundamental engineering research. The same is true in any field. This is the proper place for university research in engineering.

Another point the university must watch is to be sure that the goals of sponsored research and unsponsored research are the same. Clearly, if the goal of research in a university is understanding, then this goal is equally valid regardless of who is paying for the research. It is true that the degree to which a university can advance toward its goal of understanding will depend upon the availability of funds. But no funds should be large enough to purchase a deviation, delay, or abandonment of that goal. The university is not a supermarket where a customer should expect to find any article he wants. It is not a job-shop, prepared to turn out a custom-built gadget for each and every comer. A university is not even a bank which likes to handle money just for the sake of handling money. When money diverts effort from proper goals, then the university is literally being robbed—no matter how much "overhead" allowance is attached to the contract. A big budget which is supporting things the university has no business doing is a sham—and the real university may be suffocated under the load of padding it is forced to carry around.

It is high time, for example, that universities ceased the practice of accepting any and all gifts or contracts just because they appear to come "free." Gift-horses most emphatically should be looked in the mouth. I know of many colleges that have accepted gifts which have proved liabilities, not assets—gifts which, though "free", actually cost money—and which diverted effort and funds from proper tasks.

I have heard of an institution in which half the electrical engineering department is busily engaged in designing radar antennas—not because they are seeking to understand the radiation of electromagnetic waves, but because an Air Force contract for such gadgeteering was available. The excuse was that they could hire three more engineers that way and these men sometimes helped with the teaching. On the same principle, I suggest that the college lease and operate a five-and-dime store, so that the people who work in it can also, on the side, teach economics, marketing, human relations, and business English.

I don't want anyone to think I am unaware of the problems of financing higher education. I spent 4 years working on a Commission which studied the subject. We didn't find any easy answers. But I did not become convinced that the problem would be solved by financing things that were not higher education.

I must, of course, at this point call attention to the fact that, for better or for worse, the modern university has committed itself to carry on activities which have little relation to higher education. The state universities render a variety of services to the agricultural community which might be more appropriately handled by some sort of farm bureau. They test milk, water, fuels, and lubricants and render many other services to the local community. Most important, the universities have been called upon, and have patriotically and properly responded, to help the national defense in time of emergency. The contributions which universities have collectively made in this area are beyond calculation.

But we should not be led into thinking that designing weapons of war is a normal and proper function of a university as a university. It is an emergency function rendered, in part, because special technical talents are available in universities and, in part, because certain administrative problems are avoided and because better people are attracted to university-operated laboratories. I believe there are sometimes even indirect benefits to the teaching or research program of the institution. If the program—which is usually "secret"—can be housed and operated far from the campus as a separate establishment, it is possible that no harm will ensue.

But we should not confuse the operation of special defense facilities or services for the government with the normal educational functions of a university. We must take on these extra services, by all means, when it is necessary, desirable, or patriotic to do so. But we must get rid of them too, when possible. And in any case, in times of peace, they must not destroy the major functions of a university which are important to national defense too.

On the other hand, I must hasten to point out that the normal, proper goals of a university have in recent years been enormously advanced by federal funds under research contracts or grants. Agencies like the National Science Foundation, the Public Health Service, the Office of Naval Research, and others have rendered conspicuous service in supporting research programs in science and engineering which the universities themselves originated as a desirable part of their programs but which they could not finance. There should be more funds available for these agencies to use in this way. These funds have been wisely administered and have been a tremendous boon to science and to universities.

However, a proper research program in any field should not be abandoned, distorted, or harmed by taking on irrelevant work for which funds happen to be available—and then pretending that this irrelevant work strengthens the program which it has damaged or displaced.

There is one aspect of university research which may need clarification. You will note that in talking about research and education, I have used these terms almost interchangeably. I have spoken of research as a part of the function of higher education. I could equally well have spoken of education as a function of research. Some of you may be wondering whether I am going to discuss the conflict between teaching and research.

The answer is "No"—I haven't heard of the conflict! I have heard a lot of argument about how many hours a teacher should devote to research, but none that convinces me of a real conflict. If the purpose of a university is to advance understanding, then it follows that both the understanding of the student and of the teacher ought to go together. How a man can really teach science or engineering without acquiring a consuming curiosity about the many things that are unknown is beyond me. And how one can get a glimpse of the unknown without an equally consuming desire to tell it to others who will carry it on is also a mystery. An inquiring mind must be the chief possession of university people—and that's the only kind of a mind that can either explore the unknown or stimulate students. I think history has shown that, with but few exceptions, research laboratories go dead when not stimulated by the continued intrusion of fresh young minds. And teaching establishments also go dead when not infused by the inquiring spirit of scholarship.

I am afraid that there is a vast public relations job to be done to assist the public in understanding the real role of the university and of science. Why is it that there has grown up the widespread impression that science and gadgeteering are the same thing? Why is it that so many people—including some in industry and government—believe that the universities are in the business of making and selling gadgets? These same people have often heard that universities need money. So they naturally conclude that by buying a gadget from a university, they kill two birds with one stone—they get the gadget and take credit for helping the university. How can we make them see that actually they may be robbing the university?

Possibly we in science and engineering have overemphasized our gadgets—including the weapons—that we do produce. Possibly we need to get back to fundamentals in our public relations, and tell the world that the main purpose of science is not to produce bombs, guns, and radar, or even refrigerators, radios, and color television. Possibly we should come out boldly and unashamedly and tell the truth—the aim of the scientist and engineer is to advance human understanding. We should admit that we believe in human understanding for its own sake. We believe humans differ from the beasts largely in their ability and their urge to learn, to know, to comprehend. Men climb Mt. Everest, explore the bottom of the sea, sail to the far corners of the earth, explore the atom, the crystal, and the stars, all because they are born explorers, because men are always challenged by the unknown.

We need to go even further and re-emphasize the value of the inquiring mind. How few people there are who think of the university as primarily the meeting ground for inquiring minds. More people think of the professor as a person who earns an easy—and deservedly meager—living by reading dull lectures from dusty notes before drowsy students. Yet these same people send their sons and daughters to college in the belief that from these same courses they will learn to make a handsome living, as well as learn to be good people, patriotic citizens, and wise parents. The college graduate is supposed to know all the facts about the history of the United States, and not too much about the rest of the world; he should be alert, suave, a good public speaker, an acceptable member of the best society, and a good Republican. As he goes into business or industry, he must be humble enough to do the most menial tasks, but must never be caught uninformed on the most difficult problem. He should—but I need not extend the list of attributes which are variously expected of the students who have studied under these dull professors. The only attributes which are usually not insisted upon are that the student be inquisitive, that he be thoughtful, that he have a zest for learning and a zest for life; and that each of these qualities shall have been appreciably sharpened or enhanced by the college experience. We recognize that in training a prize fighter he must be toughened by strenuous exertion, and matched against skilled opponents. But we are afraid of intellectual toughening. We are fearful to let our young people wrestle with the toughest problems and ideas, thus learning for themselves how to find the truth—the truth about science, philosophy, economics, and politics.

It is this failure to understand the essential role of colleges and universities as tougheners of the mind, stimulators of curiosity, as the ringside of intellectual conflict that makes for much of the unjust, exasperating, and damaging criticism which higher education is now undergoing—criticism which has caused reduced or distorted financial support, unreasonable restrictions on faculties, a widespread distrust and castigation of intellectuals.

I think that all of the goals, the objectives, and the activities of a university can be brought to a focus if we think of the university as primarily a center of creative thought. It is a truism to say that all of the changes in civilization, all of changes in the way in which we live and think, have come as a result of the creative thinking of individual men and women. There are many people who appear to believe that the political and social institutions and the physical equipment of modern civilization have all somehow flowed automatically into our possession like products from the end of an enormous unthinking production line, rather than from the creative thought of individual human beings.

This creative thinking is a slow and frequently painful process. It was probably a hundred thousand years after man discovered fire before he learned to make fire do his mechanical work for him. Man's climb from his primeval state has been a long one partly because getting new ideas is so hard. We may often think that in some ways man has not progressed much since his early days, or has even regressed. But sometimes it is even hard to think of ideas which will take one backward! Nevertheless any change, whether it is eventually regarded as a good one or a bad one, has been the result of creative thought.

Now in the early days creative thought came about more or less accidentally on the parts of those few people in each generation who got new ideas. As civilization advanced, those who were interested in the examination and exploitation of new ideas banded themselves together and sometime along in the 14th or 15th century there emerged the idea of a university as a community of scholars: a community of those who were interested in creative thinking. The university enormously stimulated the advance of creative thought and it is today the prime institution in our society devoted to the stimulation of creative thinking.

It is, of course, true that not many of the hundreds of thousands of students who go through American universities each year even learn to think, and a still smaller number learn to do creative thinking. But the small number who do learn are those upon which the future of this country and of the world so heavily depends. These men and women who not only can think but can think of new thoughts, who can invent ideas that are different, are humanity's most priceless possession.

At the same time, thinking new and different ideas is a dangerous business. Such ideas must be critically examined, must be tested, must even be attacked. Wholly new ideas are seldom easily understood. Those who deal with new ideas are often subject to the criticism, and even the disdain of their fellow men.

Paradoxically enough, however, the scholars in a university also know that to a slowly increasing extent the public now acclaims those who contribute new ideas, especially if they are new ideas for gadgets which give physical pleasure to many people.

The good and important thing about a university, however, is that it encourages the development of new ideas, even though their practical value is still not evident or is unknown. For it is only through new ideas that men make their dreams come true.

Pleasures of Development Engineering

P. A. ABETTI
ASSOCIATE MEMBER AIEE

In his address on the occasion of receiving the Eta Kappa Nu Award to the Outstanding Young Electrical Engineer of 1953, Dr. Abetti discusses the challenge, and compensations, of his work as a development engineer.

A TRAVELER who had crossed the seven seas, seen many countries, and visited many people, finally came back to his home. He was asked, "What did you find in common all over the world?" He answered, not without a smile, "A certain tendency to laziness."

I think that he was right. Leonardo da Vinci discovered the law of inertia, that things if left undisturbed, will continue to stay where they are or drag along with uniform motion. This is true not only for material bodies, but also for people, for institutions, organizations, industrial enterprises, in short for every manifestation of human life. This inertia, this tendency to laziness, will prevail, will dominate life, unless something is done about it. In engineering, this is primarily the job of the development engineer, to overcome inertia and to further progress.

As a development engineer, this has been my job since my graduation $5^1/_2$ years ago. At that time I became an insulation development engineer for the General Electric Company and a good friend of mine, K. K. Paluev, warned me, "Watch out, development engineering is 5 per cent inspiration and 95 per cent perspiration." At first I was a little worried, but then I reflected that this is exactly what happens with my favorite sport: mountain climbing. Ninety-five per cent of the time you spend panting under a heavy load, slowly climbing higher and higher. The remaining 5 per cent is spent on top of the world, looking down from the lofty height you have finally reached. Now, if mountain climbing is my favorite sport and relaxation, it is only because I enjoy it. Similarly, I chose development engineering as my work, because I enjoy it, because I find many pleasures in it.

SUBJECTS FOR DEVELOPMENT

THESE pleasures of development engineering may be classified into two categories: the pleasure of developing things, and the pleasure of developing people.

Essentially full text of an address presented at the Eta Kappa Nu Annual Recognition Dinner, January 18, 1954.

P. A. Abetti is with the General Electric Company, Pittsfield, Mass.

First of all, there is the pleasure of developing things, of directing and forming them according to one's will, of making order out of disorder, shapeliness out of confusion, of creating something new and useful. This is a great pleasure because in our present age of great advances in science and engineering, things by themselves are no limitation to our desires, no limitation to our creative efforts.

Michaelangelo, one of the most complete personalities of the Rennaissance, architect, sculptor, painter, and also a very inspired poet, expressed beautifully this attitude and his faith in the powers of the creative artist. He stated that all the highest ideas of the greatest artist are contained within a block of marble; but he warned, this idea is only attained by the hand which obeys the intellect, the creative mind. I feel that the same is true of our work as engineers. In the present age any development which is not against the natural laws is within our reach. If we fail in reaching it, it is only because our hands, our tools, are not guided sufficiently by a superior mind. Thus there is a great satisfaction to know that the sky is the limit of our creative efforts and to realize that only ourselves, not science and engineering themselves, are to blame if we do not succeed in our attempt.

The pleasure of developing people is even greater, I think, than the pleasure of developing things. After all, by means of people one can develop and influence things, but not conversely. First of all, there is the pleasure of developing oneself. Upon starting a new development, in considering the problem, we realize that we know absolutely nothing about it. Then slowly we begin to read and understand the literature, to follow the attempts, the successes and the failures, of others who have worked in the field. It is a great pleasure to understand and follow what the great scientists and engineers have done in the past, to assimilate their points of view, to record their achievements, to learn gradually, to gain sufficient knowledge until we can survey the entire field.

It is just like climbing a mountain; the higher you get, the wider and clearer the view of the countryside. Then, as you reach the top, you realize the deficiencies and inadequacies, the mistakes of previous work, and finally you contribute something original to the field. This is a great pleasure, to feel higher up than everybody else, to know more than our predecessors ever have known. We should not feel presumptuous at this time, because we realize that we could have never reached this commanding position without the constant help of our teachers. They are giants, no doubt: Maxwell, Steinmetz, Heaviside, Giorgi, and many others. Compared to them, we are only dwarfs, but we are dwarfs standing on the shoulders of these giants and therefore command a higher view than they ever did. Leonardo da Vinci expressed this great truth thus: "Bad is the disciple who does not surpass his master."

Then, there is the pleasure of developing other people: colleagues, supervisors, perhaps the entire public. When you have a new promising development and begin to talk about it, the general reaction usually follows the pattern of the three following attitudes: 1. It has been done before. 2. It will not work. 3. Even if it works, we could not use it, because it would not be practical. The process of converting, of developing others to your point of view, is slow and hard work, again as mountain climbing, but it entails a great pleasure. This is not the sterile satisfaction of being able to say, "I told you so." No, it is the same kind of pleasure which the missionary must feel when he has succeeded in converting the heathen to the true and only faith.

THE EXPANDING HORIZON

Finally, the greatest pleasure of development engineering is undoubtedly the fact that the work is never finished. As soon as one development is completed, five or ten more become possible by virtue of it. Not only possible, but necessary, are these new developments in order to take full advantage of the completed one. The horizon of development is ever expanding, the stake is always higher and therefore higher the pleasure. The day that there would be nothing left to develop, nothing left to do, to create, would indeed be the saddest day of our lives. Instead we always strive towards a loftier aim, which we know we shall never attain. The pleasure contained in this ceaseless reaching has been expressed in the most perfect form by Keats. In his "Ode on a Grecian Urn," Keats describes a classical work of art wherein bold youths chase forever fair maidens. Keats addresses the pursuing young man:

Bold Lover, never, never canst thou kiss,
Though winning near the goal—yet, do not grieve
She cannot fade, though thou hast not thy bliss
Forever will thou love, and she be fair!

Likewise, the development engineer is always young, always bold, ever pursuing a new project.

Among the pleasures of development engineering there is occasionally the pleasure of recognition, of receiving awards, such as the award I have received. Of course, I realize very clearly that the Eta Kappa Nu recognition is given to me only as a symbol, because it really is due to my teachers in school and to my supervisors and colleagues in the General Electric Company. They have given me the knowledge, possibility, and, most important of all, the responsibility of performing my work in the best and most efficient manner.

There are many young electrical engineers in this country, I am sure, who deserve this award just as much, or perhaps more, than I. However, I think in my own case there is something unusually significant. This is the fact that I have been in the United States only 7 years. Yet I was received, both in school and in my work, with full trust and confidence and given a chance to show what I could do and thus to be of service to my fellowmen. In all my activities here, I have never found a person who was not willing to help me, to advise me, to co-operate with enthusiasm. This opportunity was given to me; and I will be forever grateful for it to my teachers, to my company, and to this country. If this opportunity will continue to be available to others in the future, then certainly the electrical industry and our country will continue to prosper, and at the same time we will keep faith with our American ideals.

Speed-Torque Calculations for Induction Motors

P. L. ALGER
FELLOW AIEE

Y. H. KU
FELLOW AIEE

C. H. T. PAN
ASSOCIATE MEMBER AIEE

THERE HAS recently been a renewed interest in the part-winding method of securing reduced starting current with moderate starting torque values for polyphase induction motors in sizes of 50 hp and larger. The most usual scheme is to provide the motor with two identical parallel circuits in the stator winding, and to connect only one of these circuits in each phase to the power supply for starting. After a brief interval, the remaining circuits are connected, and the motor then operates in a normal way.

In this manner, the initial current inrush to the motor is reduced to about 2/3 of the normal full-voltage value, and it thus is possible to connect considerably larger motors to the lines for full-voltage starting, without exceeding a specific value of allowable starting current.

However, the accelerating torque with part winding is likely to be very low for an induction motor with normal air gap and winding proportions; and the motor often will crawl at a low speed; due to the presence of severe dips in the torque curve, caused by harmonics of the air-gap field. For this reason, the second half of the winding must often be connected before the motor has attained any considerable speed, with the result that the final current inrush is practically as in normal full-voltage starting. Nevertheless, the result may be satisfactory, since it is often permissible to draw high currents from the power supply for short periods, provided that the current is taken in two or more successive increments, with a suitably small current per step, and a suitable time interval between. Such incremental starting is allowed on the assumption that voltage-regulating means will have time to adjust the voltage between steps, so that the voltage dip and corresponding light flicker will be held to lower values than if the full current were taken in a single step.

During the initial starting period, when only 1/2 the winding is in circuit, the current density in the stator copper will be of the order of 4/3 of the normal full voltage starting value (assuming the locked rotor current is 2/3 of normal) and the stator copper temperature will, therefore, rise at a rate about 1.8 times as fast as normal. Also, due to the reduced torque, the starting time will be much longer than normal. Allowance must be made for this by using a more liberal amount of stator copper than otherwise required, or accepting a smaller margin of safety. Other considerations also enter, which further offset the apparent advantages of part-winding starting.

In view of these considerations, it is necessary greatly to improve the accelerating torque usually obtained with part-winding starting, if the method is to have any broad usefulness. It is, therefore, worth while to study the factors that cause the torque dips that are characteristic of part-winding starting, and to develop means for their calculation and control. For this purpose, extensive tests were made on two different motors, and the results were compared with torque and current values calculated by a harmonic analysis and equivalent circuit procedure.

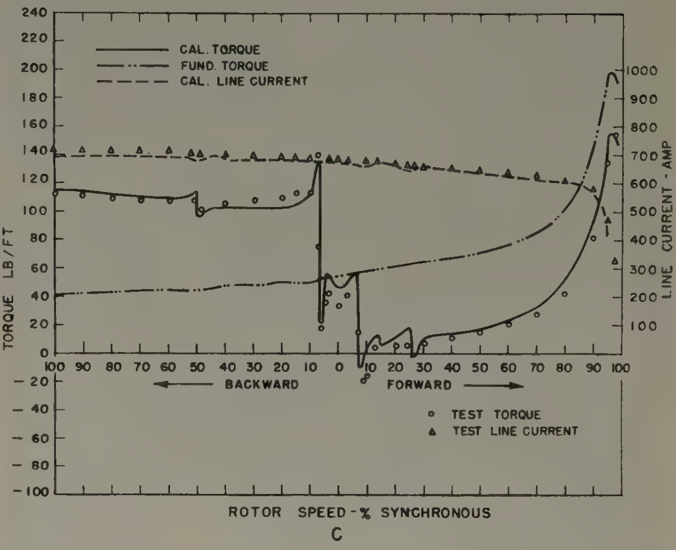


Fig. 1. Speed-torque-current curves for 6-pole motor with part winding, omitting alternate slots

Fig. 1 compares the test and calculated torque values for a 4-pole 40-hp motor with an alternate slot part winding. As shown, there is a very high negative torque, or load loss, due to harmonic fluxes over the speed range from about 8 per cent to full speed in the forward direction; and there is a large positive or braking torque due to the same cause for all reversed speeds higher than 8 per cent. These large harmonic torques are of the same character as the ordinary stray load losses of a motor, but are greatly exaggerated because of the half number of slots in the part winding.

In the equivalent circuit analysis, the permeance harmonics are neglected, as they are of relatively insignificant magnitudes. Each mmf harmonic is represented by an ideal motor. These ideal motors share the same mechanical parts while they are electrically connected in series. At a given rotor speed, the torque of each harmonic may be calculated independently of the others. The algebraic sum of all harmonic torques is the total developed torque. The total developed torque less the losses in the copper and iron parts and in friction and windage gives the net available shaft torque. In this manner, the complete shaft-torque versus rotor-speed curve may be calculated.

Digest of paper **54-8**, "Speed-Torque Calculations for Induction Motors With Part Windings," recommended by the AIEE Committee on Rotating Machinery and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954. Published in AIEE *Power Apparatus and Systems*, April 1954, pp. 151–60.

P. L. Alger and **C. H. T. Pan** are with the General Electric Company, Schenectady, N. Y., and **Y. H. Ku** is with the Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.

TEN FOUNDING FATHERS OF ELECTRICAL SCIENCE

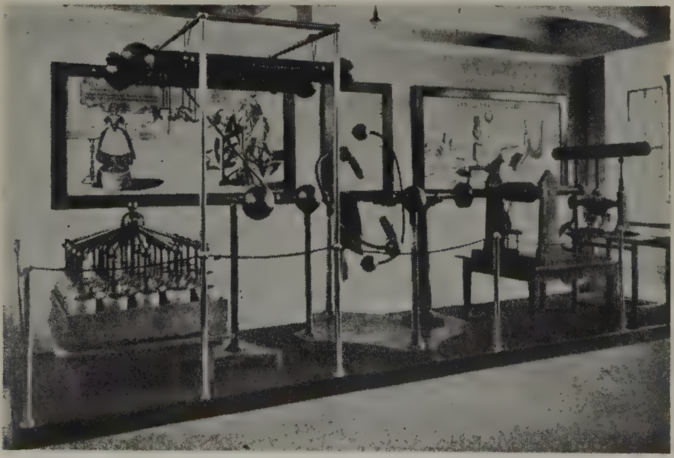
VI. GEORG SIMON OHM

and the law of electric flow

BERN DIBNER
FELLOW AIEE

Georg Simon Ohm, a mathematician and experimenter whose analysis established the law determining the flow of an electric current in a conductor, clarified the distinction between current intensity and quantity and "resolved a subject of vast importance, and hitherto involved in the greatest uncertainty."

THE CONDUCTION of an electric charge traveling along a conductor was established by Stephen Gray, working in London in 1731. Gray demonstrated that by using a pack-thread over 750 feet long, an electric charge produced by rubbing a glass tube at one end of this thread would cause an ivory ball to be attracted to the thread at the other end. A century later, a physicist and mathematician, Ohm, adopted this problem as a major item of interest. The discovery by Oersted of the relationship of magnetism to electricity had inspired a new group of experimenters to search further into determining the laws of behavior of this new force. Ampere had provided the concept of "potential" electricity between the ends of a wire carrying current from the terminals of a voltaic cell. Further, the physicist Fourier had established that the flow of heat in a metal bar was directly proportional to the difference of temperature between the ends of the bar. Ohm applied this analogy of flow of heat in a metal bar to the flow of an electric current in a conductor, by using Fourier's concept of the temperature gradient and also by imagining the distribution of current along sections of a homogeneous metal ring. He wrote that "the force of the current in a galvanic circuit is directly as the sum of all the tensions [along the ring] and inversely as the entire reduced length of the circuit." The difference in the values of the force at two points of a circuit would provide the required "driving-power" acting on the current between these two points. Ohm was relying on an earlier concept of Volta's theory of the electrostatic "tension" on an open pile.



Left, electrostatic machine and Leyden jar battery used by Ohm in 1830; at right, von Guericke's generator. At the Deutsches Museum, Munich, Germany

Of humble origin, the son of a locksmith, he had persevered in his struggle to obtain an education, which consisted of a course at the "Gymnasium" at Erlangen and three terms at the university. With money saved as a tutor, he completed his course and then accepted a teaching post at Cologne. It was here that he experimented and completed his major work in the nature of a galvanic circuit. In this study he investigated the nature of unipolar conductors, the relative conductivity of various metals, and the theory of the galvanometer. Aware of the importance of the task of resolving the forces in a galvanic circuit, Ohm, in April 1826, got a leave of absence from the university and, at his brother's home in Berlin, he applied himself for the next year to the problem and the preparation of his book.

Ohm summed up his theory and deductions on the characteristics of a galvanic circuit, concluding: (1) In a closed voltaic circuit, the same quantity of electric current passes across each section perpendicular to the direction of current flow irrespective of the form of the conductor. (2) Changes made in any portion of the circuit affect its entire action. (3) The current flow is in direct ratio to the electromotive force and in inverse ratio to the circuit resistance. The resistance of a circuit is the sum of the resistance of the liquid conductor and the wire which connects its terminals. If a number of voltaic cells is in series in a circuit, the current is proportional to their number if the external resistance is very large, but is independent of their number if the external resistance is small.

Ohm thus formulated the basic law of electrical science known by his name. He considered the term *electromotive* force as the force driving the current through the conductor, and thought of the current and resistance much in the same sense as today. Ohm's law, once grasped, has become the

---

Bern Dibner is president, Burndy Engineering Company, Inc., Norwalk, Conn.

basis of determination of all electric circuits. His pioneering mind had to bridge the gap between the behavior of a static charge and the steady flow of a voltaic current. He had to reconcile the fact that whereas a static charge exists only on the surface of a conductor, an electric current in flowing through a conductor occupies the surface and also the entire cross section of the wire.

Ohm's attention had been drawn to the work being done by Barlow in London and Becquerel in Paris on the conductivity of wires of differing lengths and diameters but of the same material. Ohm had noted a difference in their reported results and set out to reconcile these differences through experiments of his own. Using a copper-zinc voltaic battery, he connected the ends of this battery to two mercury cups. Into these cups he placed six wires ranging from 4 inches to 23 feet long, one at a time. The shortest wire was rather thick but the rest of the wires were uniformly 0.03 inch thick. Over each conductor was placed a torsion balance, the deflection of which registered on the needle and indicated the magnitude of the current. Ohm used the thick conductor as a standard of reference against the deflection for each of the other conductors. Using the readings on the balance he arrived at the relationship:

$$v=m \log\left(1+\frac{x}{a}\right)$$

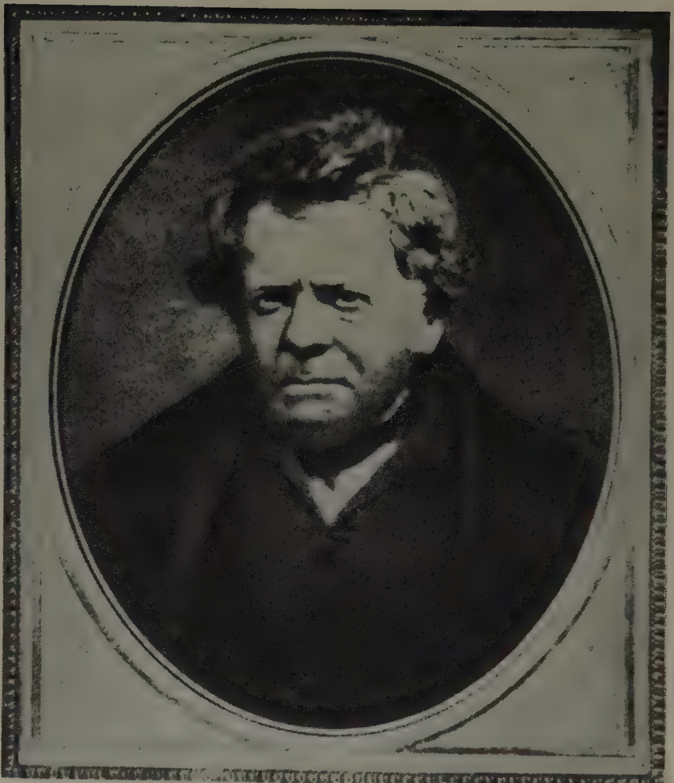
in which v is the decrease in force, x the length of the conductor, and a the length of the thick wire (the conductor of reference). For the coefficient m, Ohm says, "The coefficient m is a function of the standard force, of the thickness of the conductor, of the quantity a, and, as I have reason to believe, of the electric tension of the force. I am at the moment still engaged in making quite sure, through more exact experiments, of the exact nature of this function."

In a paper appearing in Schweigger's *Journal* in 1826 he summed up the results of his experiments and restated his law: "Electrical conductors of the same substance, but different diameter, have the same conductivity values in their lengths in proportion to their cross section."

The title of this paper bore the involved name "Determination of the Law in Accordance with which Metals Conduct Electricity, Together with an Outline of a Theory of the Voltaic Apparatus and of Schweigger's Multiplier."

It is, undoubtedly, the ambiguity of his presentation in this paper (expanded in 1827 into book form titled "Die Galvanische Kette") that caused it to remain unnoticed and unaccepted for many years. This embittered the author, whose paper was called foolish.

As a result of the criticism of his book he lost his position at the university and went into retirement for 6 years and had to earn his living by tutoring and odd jobs. Twenty-two years later, his contribution was recognized for its worth, but he was 60 years old when he was appointed to the chair in physics at the University of Munich. England had awarded him the Copley Medal of the Royal Society in 1841 and in the following year he was made a Foreign Associate of the Royal Society, a distinction previously won only by one other German, Gauss. At the presentation of the Copley Medal it was stated Ohm had resolved "a subject of vast importance, and hitherto involved in the greatest uncertainty." The Council of the Royal Society in granting the medal pointed out, further, that Ohm had clarified the distinction between current intensity and quantity and had proved that the magnitude of current flow was equal to the sum of all the electromotive force divided by the sum of the resistances. This was true irrespective of the nature of the source of the current, whether thermoelectric or of voltaic origin; if the quotient is equal, the effect is the same. Thus, the recognition of Ohm's contribution first was made abroad and slowly returned to the area of its source. In his book Ohm also confirms Davy's observation that the conductivity of the metals he used increased by the lowering of temperature and was decreased by raising it.


From a painting at the Deutsches Museum

Georg Simon Ohm

The fame and name of Georg Simon Ohm (he was christened Johann Simon Ohm) is locked in perpetuity in a law and in a term that will be used as long as electricity flows, and yet with not a century between our time and the date of his death, we have no record of the exact place of his birth. Further, because of erroneous dates on tablet and tombstone, even the date of his birth often is given in error; he was born March 16, 1789, somewhere in Erlangen in Bavaria. Following the depressive slump that resulted from the failure of his colleagues to evaluate his book properly, Ohm moved from school to school in minor teaching positions until 1849 when the coveted professorship of physics at the University of Munich came to him. To his electrical studies he added research in molecular physics, interference phenomena of polarized light, acoustics, and telegraphic communication. The International Electrical Congress, meeting in Paris in 1881, established the "ohm" as the standard unit of electrical resistance.

Controls for Operating Steam Turbine Generators

O. N. BRYANT

C. C. STERRETT
MEMBER AIEE

D. M. SAUTER
ASSOCIATE MEMBER AIEE

THE INDUSTRY IS at present engaged in designing and building turbine generators in ever-increasing sizes. The operation of turbine-generator units necessitates the use of a multitude of controls.

Basically, the controls of steam turbines can be divided into those for the control of the flow of steam, and those for the protection of the turbine in case of failure of the main steam controls, or of the main oil pump. The block diagram, Fig. 1, shows the relation between the component parts of the control system of the turbine.

The main steam controls include the servomotors for moving the governing valves which determine the steam flow to the turbine, the speed-responsive governor, and the speed-changer which adjusts the speed range in which the governor will control the servomotors. A load limit device also is provided to limit the maximum opening of the governing valves to any chosen amount.

The protective controls include the throttle valve, the overspeed governor and its connecting devices for tripping the throttle valve closed whenever the turbine reaches a predetermined overspeed, and the auxiliary oil pump with its pressure responsive controls which cause the pump to start in case of incipient failure of the supply of bearing lubricating oil, or of the supply of high-pressure oil which actuates the valve servomotors.

These comprise the basic controls that are applied to all straight condensing turbines whether tandem-compound or cross-compound. Since cross-compound turbines are not located on the same shaft, an auxiliary governor, an overspeed governor, and a bearing oil trip must be supplied for the lower pressure turbine. A reheat turbine will need the following auxiliary controls: interceptor valves, auxiliary governor, reheater stop valves, and interlocking relays.

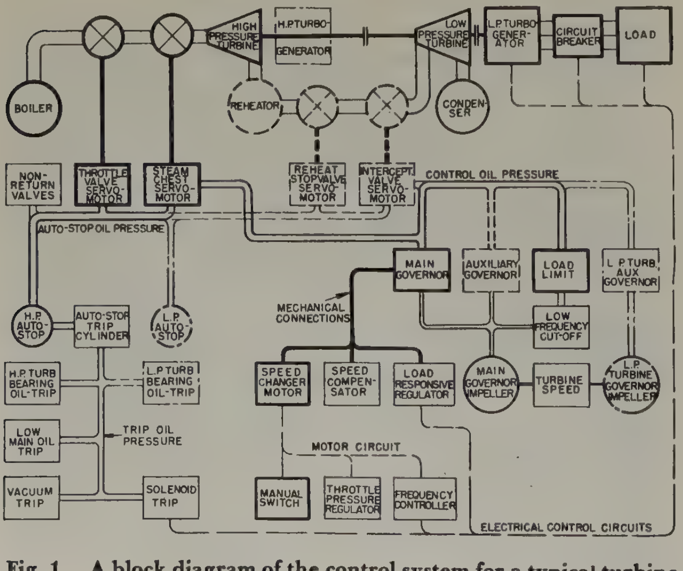


Fig. 1. A block diagram of the control system for a typical turbine

The following accessory controls also are available for operation of any turbine: low-bearing oil-pressure trip, low-vacuum trip, throttle pressure regulator, low-frequency release for load limit, speed compensator, load responsive governing.

The main devices that are available for controlling the generator include stator, gas, and rotor temperature recorders, electric metering instruments, and capability curves. The temperature readings sometimes are used as the sole guides for operating the generator. However, the manufacturers always have recommended that hydrogen-cooled generators be loaded according to capability curves.

It is generally recognized that the standard stator temperature detectors indicate unusually low temperature rises at higher hydrogen pressures. Thus, the emphasis on loading according to capability curves is based on the fundamental limitation of the stator temperature detectors. These curves take into consideration the aging effects of total temperature as well as temperature rise which causes differential expansion of the component parts. Temperature readings, therefore, should be taken and recorded, but their primary purpose should be to indicate incorrect operation or changes in the generator.

A hydrogen-cooled turbine generator is provided with a gas and oil system. The primary functions of the hydrogen control system are to provide for scavenging and filling the generator housing; to maintain the gas within the generator housing within predetermined purity, pressure, and temperature limits and free of moisture; and to give warning of improper operation of the generator or failure of the hydrogen control system. These functions must be performed for running and standstill conditions.

The most common types of protective devices used on generators are differential relays, loss-of-field relays, and field ground detectors. Over and above these three devices there are relays which provide protection for excessive negative sequence currents, out-of-step operation, antimotoring, overvoltage, overspeed, single phase, vibration, malfunctioning of cooling system, bearing temperature, and fire.

Turbine-generator controls can be provided for remote indication and these indicators also can be provided with limit switches to operate warning devices. Supervisory instruments can be provided for the turbine generator to detect shaft vibration, thrust bearing wear, and differential expansion between the turbine casing and the turbine rotor. This information can be recorded continuously and any marked deviation can be noted and investigated.

Digest of paper 54-154, "Controls for Operation of Steam Turbine-Generator Units," recommended by the AIEE Committee on Power Generation and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954. Published in AIEE *Power Apparatus and Systems*, February 1954, pp. 79–88.

O. N. Bryant is with Westinghouse Electric Corporation, Philadelphia, Pa., and **C. C. Sterrett** and **D. M. Sauter** are with Westinghouse Electric Corporation, East Pittsburgh, Pa.

Differential Phase and Gain Measurements in Color Television Systems

H. P. KELLY

Differential phase-and-gain distortion in systems used for color television transmission results in distortion of the colors being transmitted. A test set, consisting of a portable transmitter and receiver, for measuring differential phase and gain is described.

COLOR television has imposed new requirements on transmission circuits. The nature of the color signal is such that circuits used for its transmission must meet very stringent linearity requirements. The minimizing of differential phase and gain at the color carrier frequency is one of the more important of these new requirements.

The National Television System Committee color television system is based on the principle that color may be adequately defined in terms of three characteristics: luminance, hue, and saturation. Luminance defines intensity or brightness and is the basis on which the present monochrome or black-and-white system of television operates. Hue defines the color in terms of whether it is red, blue, green, yellow, or the like. Saturation defines the degree to which the hue is mixed with white. Pink is a low-saturation red; brilliant crimson a high-saturation red.

The color signal, therefore, must contain information as to these three characteristics. The color system uses the same type of signal to transmit luminance information as is used in the black-and-white system, therefore the transmission of this portion of the signal presents no new problems. The other two parts of the signal containing the hue and saturation information are added to the luminance information and comprise the new elements in the television signal. It is the necessity of transmitting three pieces of information instead of one, simultaneously, and without interaction or distortion, which has imposed the new requirements on transmission circuits. This situation is analogous to the transmission of two or more voice signals simultaneously in a carrier telephone circuit. If the circuit is perfectly linear, there is no difficulty in separating the various voice channels at the receiving end. If the circuit is not linear, the channels interact with one another and crosstalk occurs.

In the case of color television, the saturation and hue information are added to the luminance information in the form of a new signal called the color carrier. The amplitude of this signal represents the saturation of the color. A large amplitude represents high saturation or a brilliant color. Distortion of color saturation will occur if the gain of the transmission system to the color carrier is different for different amplitudes of the luminance signal. This variation in the amplitude transmission of the color carrier signal caused by variation in the amplitude of the luminance signal is called differential gain. The presence of differential gain in a system used to transmit color television may result in a picture in which some colors may appear dim or washed out while others may appear oversaturated.

The time or phase relationship of the color carrier signal to a reference synchronizing signal (color burst) determines the hue of the color. Distortions of hue will occur if the transmission system produces a different phase shift in the color carrier at different amplitudes of the luminance signal. This variation in phase shift caused by variations in amplitude of the luminance signal is called differential phase. The presence of differential phase in a system used to transmit color television results in a change in the hue of the colors.

The term "differential gain" was first proposed by S. Doba. The method of measurement here presented follows along lines suggested by Doba. This method is one of several* which might be used to measure differential phase

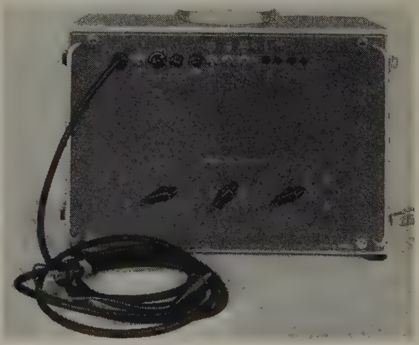


Fig. 1. Panel view of transmitter

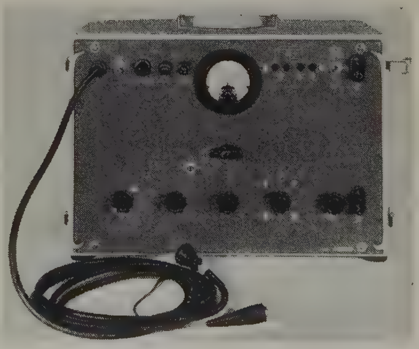


Fig. 2. Panel view of receiver

---

* An alternate method has been used by R. C. Edson of the Bell Telephone Laboratories.

Full text of a conference paper presented at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954, and recommended for publication by the AIEE Committee on Television and Aural Broadcasting Systems.

H. P. Kelly is with Bell Telephone Laboratories, Inc., Murray Hill, N. J.

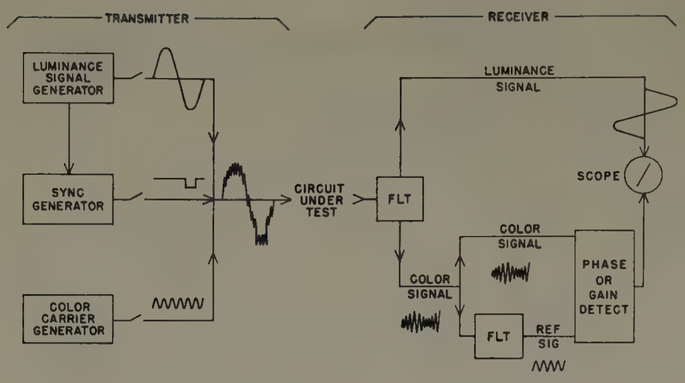


Fig. 3. System block schematic

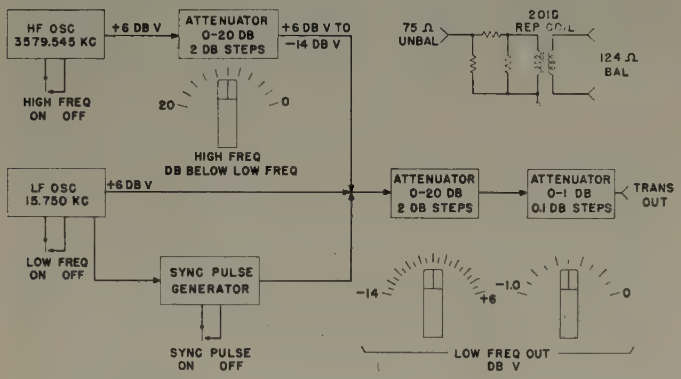


Fig. 4. Transmitter block schematic

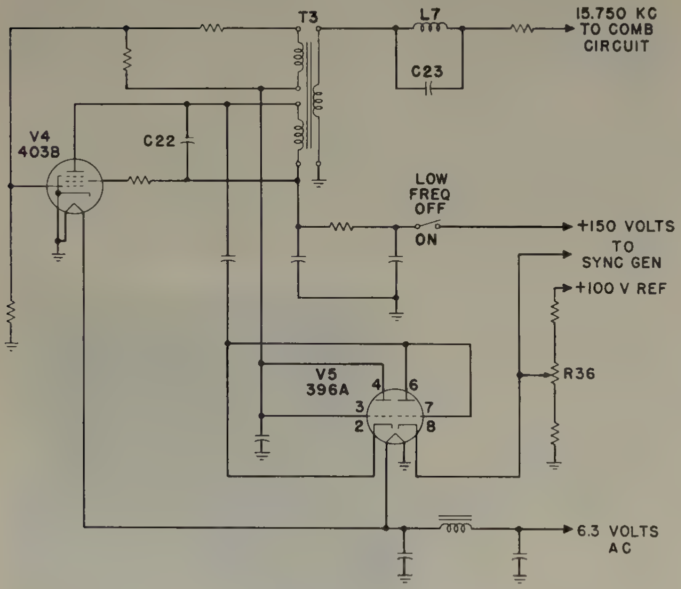


Fig. 5. Low-frequency oscillator

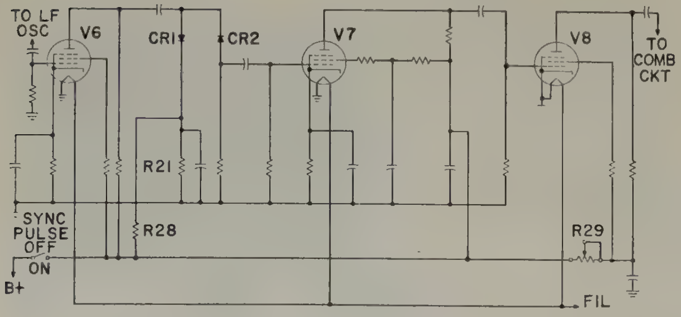


Fig. 6. Sync generator

and gain and was selected as giving the desired results quickly and accurately.

A test set for measuring the presence of differential phase or gain at the color carrier frequency in television systems has been developed by the Bell Telephone Laboratories, Inc. It consists of two pieces of portable equipment: a transmitter and a receiver. The purpose of the transmitter is to generate a signal which simulates a color television signal. This signal is connected into the input of the system being tested. The purpose of the receiver is to examine the signal at the output of the system being tested to determine if it has been subjected to differential phase or gain.

The transmitter and receiver are physically independent of each other. The only connection between them is the circuit being tested. This independence is necessary for Bell System use since the transmitter and receiver might be separated by thousands of miles of transmission networks.

Figs. 1 and 2 show panel views of the transmitting and receiving units, while Fig. 3 is a simplified block diagram of the system.

The transmitter consists of three major parts: a luminance or black-and-white signal generator, a sync pulse generator, and a constant color carrier generator. The luminance signal generator is a 15.750-kc sine-wave oscillator. The amplitude of this signal can be adjusted to represent a full range of luminance from dark to bright. The sync pulses are derived from the negative peaks of the luminance signal and therefore their positioning on the negative peaks is automatic. The color carrier generator is a 3.579545-mc crystal oscillator. Its output represents a constant hue and saturation signal. The foregoing three signals are combined at the output of the transmitter. The transmitter therefore sends a signal into the system under test which consists of a constant color carrier signal superimposed on a luminance signal which is continuously varied over the entire range from dark to bright. It can be seen that the effect of the luminance signal is to change the position of the color carrier in the amplitude range of the transmission system. It is this change in position which gives rise to differential phase and gain.

At the receiver, the luminance signal and color carrier are separated by means of a filter. The luminance signal is applied to a cathode-ray oscilloscope in such a manner that it produces a left to right deflection of the beam. The left to right position of the beam, therefore, is an indication of the instantaneous amplitude of the luminance signal with the extreme left indicating the dark level and the extreme right indicating the bright level. The received color carrier has been drawn to show the presence of differential gain.

The color carrier signal containing any such variation which might have been produced in the system under test is split into two paths. The signal in one of these paths is transmitted through a sharp filter which removes any variation present and provides at the output of the filter an undistorted color carrier signal. This signal is used as a reference against which the distorted signal in the other path is compared. The comparison is made in the detector. The function of the detector can be switched to make a comparison with respect to either amplitude or phase.

When differential gain is being measured, the comparison is made on an amplitude basis. A voltage is obtained at the output of the detector which is proportional to the difference in amplitude between the distorted and reference signals. In a similar manner, when differential phase is being measured, a voltage is obtained at the output which is proportional to the instantaneous difference in phase between the distorted and reference signals. In either case the output of the detector is applied to the oscilloscope in such a manner that it produces an up and down deflection of the beam. The amount by which the beam is deflected vertically is a measure of the amount of differential phase or gain present in the circuit under test. The presentation of the complete measurement is therefore a line on a cathode-ray tube. This might be considered as a graph in which the amplitude of the luminance signal is plotted as a horizontal co-ordinate against differential gain or phase in the vertical co-ordinate. The sensitivity of the measurement is such that the amount of distortion which is considered just perceptible causes the beam to be deflected vertically one inch. This sensitivity makes it possible to measure and hence correct for distortions which are quite a bit below perceptibility. This is necessary because a long television network might consist of a number of shorter links. If the over-all network is to produce only a moderate or imperceptible degradation, then each link must be adjusted to be almost perfect in itself.

Fig. 4 is a block schematic of the transmitter showing the arrangement of the luminance generator, sync generator, color carrier generator, and the level adjusting attenuators.

A simplified schematic of the luminance or low-frequency signal generator is shown in Fig. 5. *V4*, *T3*, and *C22* comprise a 15.750-kc oscillator circuit. *V5* and associated components form a peak-to-peak detector circuit which is used to provide automatic volume control for the oscillator. The detector circuit is back biased by a positive d-c reference voltage on cathode pin *8*. So long as the peak-to-peak value of the 15.750-kc sine wave on the plate pin *5* of *V4* does not exceed the d-c reference voltage on the detector, no d-c output is obtained at pin *4* of detector *V5*. However, when the peak-to-peak value does exceed the reference voltage, a negative direct voltage is obtained at pin *4* of *V5* which is proportional to the amount of this excess. This voltage is fed back as bias to the grid of the oscillator tube and thus tends to limit the output of the oscillator. Potentiometer *R36* provides a means of varying the reference voltage to the detector and thereby the output of the oscillator. The reference voltage is supplied from a voltage reference gas tube. Changes in output of less than ±0.1 db are obtained for ±10-per-cent variations in supply voltages. Frequency accuracy is of the order of ±1 per cent. A voltage which represents a small portion of the positive peak of the sine wave is obtained at pin *8* of the diode. This voltage is transmitted to the sync generator.

A simplified schematic of the sync generator is shown in Fig. 6. This circuit consists of tubes *V6*, *V7*, and *V8*, *CR1*, and *CR2*, and associated components. The sine-wave tips from the low-frequency generator are amplified and shaped into sync pulses in this circuit. *R29* provides a means of adjusting the amplitude of the sync pulse output.

A simplified schematic of the color carrier generator is

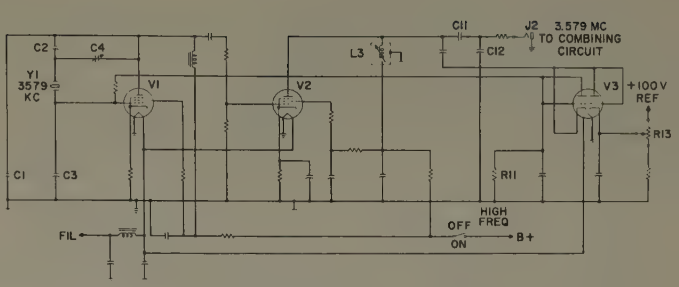


Fig. 7. **High-frequency oscillator**

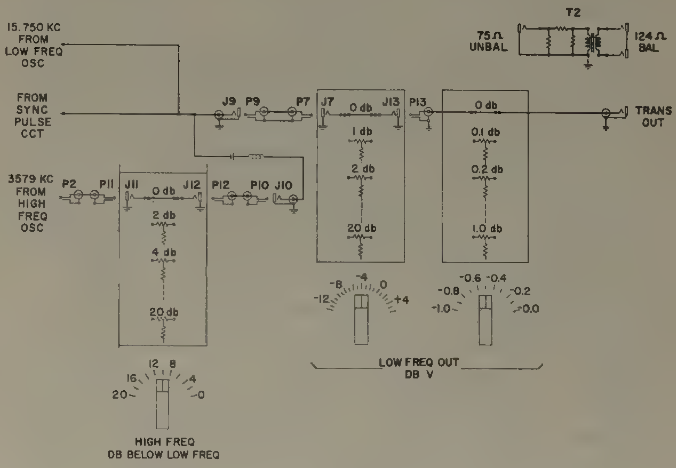


Fig. 8. **Combining and output circuit**

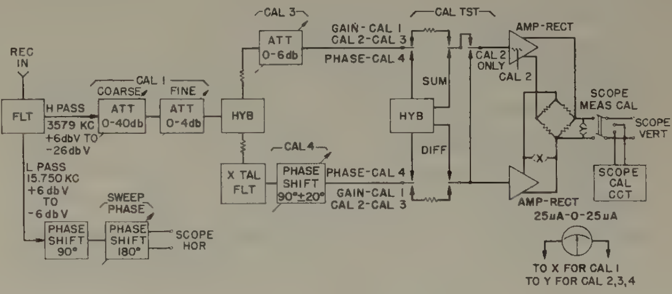


Fig. 9. **Receiver block schematic**

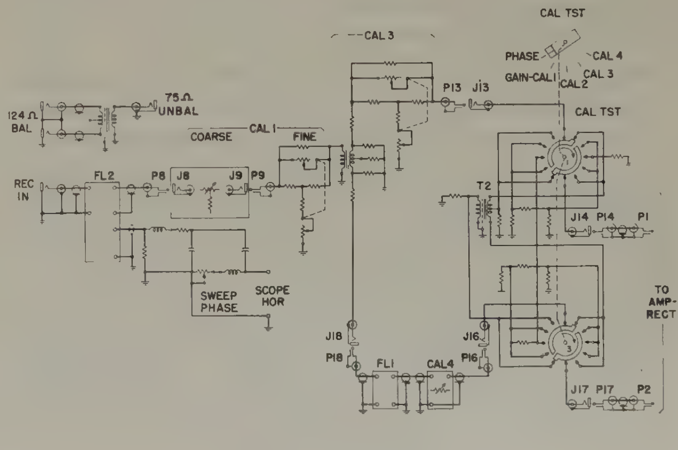


Fig. 10. **Input circuit**

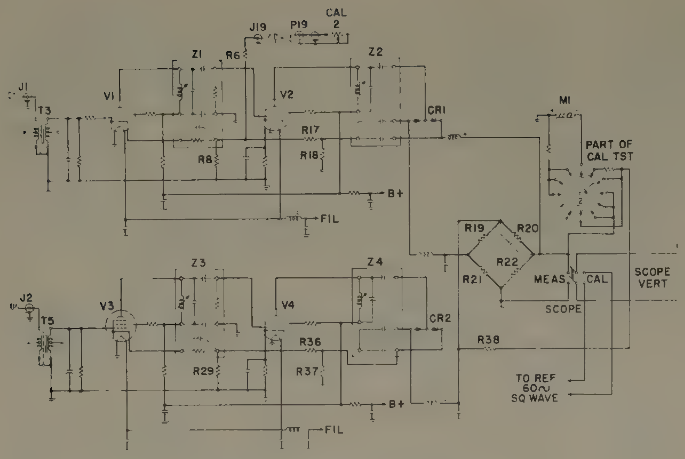


Fig. 11. Amplifier-rectifier

shown in Fig. 7. It consists of a 3.579545-mc crystal oscillator, *V1*, a buffer stage, *V2*, and an automatic volume control circuit, *V3*, which is similar in its operation to that described for the low-frequency oscillator. Potentiometer *R13* provides for adjusting the output of the oscillator.

The luminance, sync, and color carrier signals are combined as shown in Fig. 8. The output of the color carrier generator is transmitted through an attenuator before it is combined with the other two signals. This attenuator is designated HIGH FREQ—DB BELOW LOW FREQ and is used to establish the ratio between the high- and low-frequency amplitudes. The combined output is transmitted through a pair of attenuators, designated LOW FREQ OUT—DBV (decibels from one volt). These attenuators are calibrated in terms of the low-frequency or luminance signal output and cover a range of +6 dbv to −15 dbv in 0.1-db steps. A repeat coil is provided so that either a balanced 124-ohm output or an unbalanced 75-ohm output can be obtained.

A block schematic of the receiver is shown on Fig. 9. The filter at the input consists of a pair of complementary low- and high-pass filters with their inputs connected in parallel. This filter is used to separate the luminance signal and the color carrier signal. The low-frequency luminance signal is obtained at the output of the low-pass section. The high-frequency color carrier signal is obtained at the output of the high-pass section. The SWEEP PHASE control in the luminance signal path provides for the adjustment of the horizontal sweep so that the extreme left-hand end of the oscilloscope trace represents the black level of luminance. The high-frequency color signal is split into two paths in the first hybrid coil. The sharp crystal filter in one of the paths removes any distortion which might have been produced in the system under test and provides at its output, an undistorted reference signal. This signal is used as a reference against which the distorted signal in the other path is compared. The CAL TST switch provides the various circuit arrangements necessary for measuring differential phase or gain, or for calibrating adjustment. When measuring differential gain, the reference and distorted signals are compared on an amplitude basis. The reference and distorted signals are each connected to the input of an amplifier-rectifier. The rectified outputs are compared in a bridge circuit and a voltage representing their difference is connected to the vertical input of an oscilloscope. The two amplifier-rectifiers are adjusted to have equal sensitivity by means of the CAL 2 control. Therefore, if at any instant the reference and distorted signals are equal in amplitude, the output from the bridge circuit is zero.

When differential phase is being measured, the reference and the distorted signals are compared on a phase basis. The two signals are connected into a pair of conjugate branches of a hybrid coil. The two outputs from the other pair of conjugate branches represent the vector sum and the vector difference of the two signals. The vector sum is connected to the input of one of the amplifier-rectifiers and the vector difference to the other. The outputs are combined in the same manner as for differential gain. The output from the bridge circuit at any instant is proportional to the phase difference between the reference and distorted signals. Zero output is obtained from the bridge when the two signals are 90 degrees out of phase.

The CAL 1 position of the switch provides the same circuit arrangement as for GAIN. The CAL 1 control is used to adjust the input level for the proper value of rectified current from the reference signal amplifier-rectifier as indicated by a reading of 20 microamperes on the panel meter.

The CAL 2 position of the switch provides for connecting the reference signal to the input of both amplifier-rectifiers. The panel meter is connected to the output of the bridge circuit. The adjustment of the CAL 2 control for zero output from the bridge then provides equal sensitivity in the two amplifier-rectifiers.

The CAL 3 position provides the same circuit arrangement as for GAIN except that the meter is connected to the output of the bridge. The CAL 3 control is then adjusted for equal transmission in the two paths as indicated by a zero reading of the meter.

The CAL 4 position is the same as the PHASE position except that the meter is connected to the output of the bridge circuit. The CAL 4 control is adjusted in this position to obtain a 90-degree difference in phase shift in the two paths as indicated by a zero reading of the meter.

Simplified schematics of the input circuits and amplifier-rectifiers are shown on Figs. 10 and 11. Each of the two amplifier-rectifier circuits consists of a 2-stage 3,579-kc amplifier terminated in a varistor rectifier. Each circuit has approximately 26 db of negative feedback. Since the rectifier circuit is included in the feedback loop, a high degree of linearity and stability is obtained.

This set provides approximately 50 millivolts to the vertical input of the oscilloscope for 1 db of differential gain or 5 degrees of differential phase. A number of oscilloscopes are available which will provide a 2-inch vertical deflection for this voltage. A 50-millivolt calibrating signal is available in the receiver for adjusting the vertical sensitivity of the oscilloscope.

REFERENCE

1. Test Instruments for Color Television, **W. C. Morrison, K. Karstad, W. L. Behrend.** *Proceedings*, Institute of Radio Engineers, New York, N. Y., vol. 42, January 1954, pp. 247–58.

Methods for Determining Primary Feed Points

D. L. HOPKINS
ASSOCIATE MEMBER AIEE

D. R. SAMSON
ASSOCIATE MEMBER AIEE

IN ORDER TO determine the future feed points that will be necessary to supply the primary system, the distribution planner must approach the problem with a realistic and logical sequence of steps. These steps would be: 1. determine the future load densities for the various areas of his system; 2. determine the number of feed points needed to supply these areas with several methods of primary feed arrangement, and 3. determine the most economical means of supplying these feed points.

In studying the primary system necessary to feed a given area, there are a variety of patterns or circuit configurations that could be used. Normally the final decision on an exact pattern is tempered by local factors, such as right-of-way, geography, and other such limitations. However, it is usually convenient to neglect these local considerations in the first approach to the problem. This simplification permits one to evaluate the theoretical solutions and then temper these answers with actual field conditions. It is for these theoretically ideal load conditions and area that the feed point formulas are to be developed.

Fig. 1 illustrates the shape of an area that might be served by one feed point. As usually would be the case with overhead lines, the size of this area is voltage limited. Thus, the voltage drop between the feed point and the primary of the last distribution transformer would determine how much area could be served by one feed point.

Simple equations have been developed which will allow the distribution engineer to plot curves similar to those in Fig. 2 for a particular set of line constants; i.e., voltage, conductor size, power factor, distance between laterals. Knowing the approximate load density in an area, the curve may be entered and the area served by one feed point taken off the ordinate for the desired voltage drop.

Fig. 3 indicates the main and lateral losses from one feed point for the same line constants. These curves were obtained from additional equations and are helpful in making an economic analysis of future distribution voltages.

The equations for area and losses were used in making an economic analysis and as a result, it was found that even though the equations are for a particular shape of load area, they can be used safely for any shape of area without introducing a significant error.

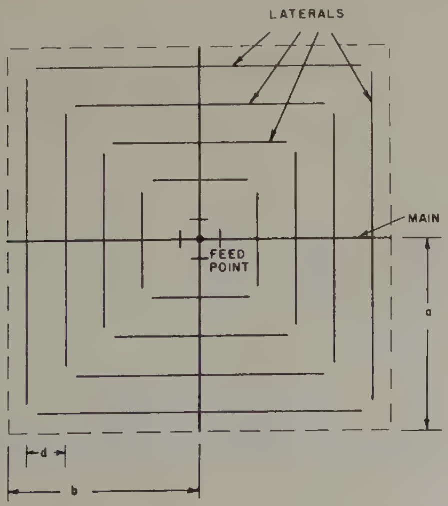


Fig. 1. Grid method of primary feed

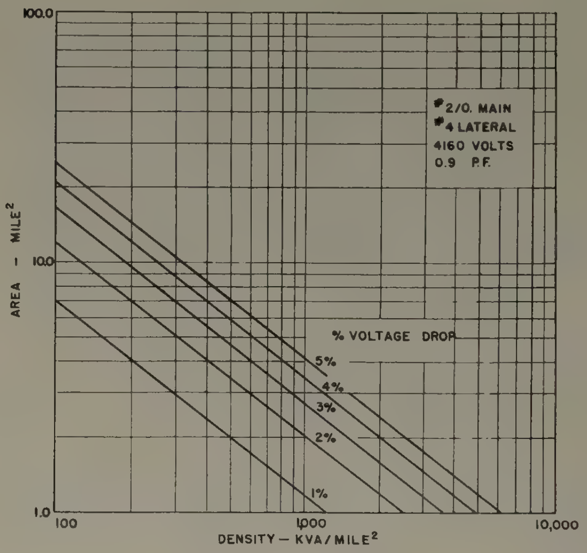


Fig. 2. Area coverage as a function of load density for grid feed

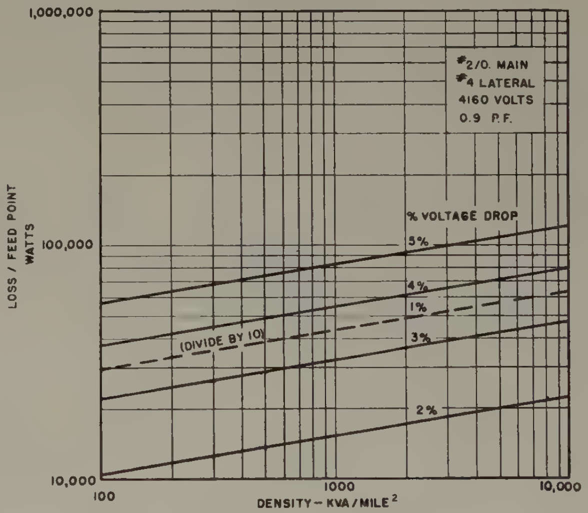


Fig. 3. Total grid loss as a function of load density

Digest of paper 54-142, "Useful Methods for Determining Primary Feed Points in Future Distribution System Planning," recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1954.

D. L. Hopkins and **D. R. Samson** are with the General Electric Company, Schenectady, N. Y.

What Is Ferrimagnetism?

L. R. MAXWELL

Although the need for a theory of ferrimagnetism has existed for over 2,000 years, this has only become obvious for about a decade. The importance of Néel's suggestion that possibly within a given domain not all of the magnetic ions have their magnetic moments arranged parallel to each other is discussed at some length, and the hope is expressed that in the future a ferrite may be obtained which is ferromagnetic.

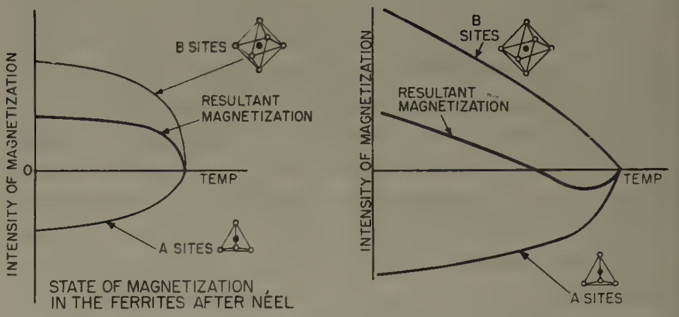


Fig. 2 (left). Graphical illustration of the thermal behavior of ferrimagnetism. Fig. 4 (right). A qualitative explanation of the "bouncing"-type thermomagnetic curves

IN ferromagnetism intuitively one thinks of a material composed of small elementary bar magnets arranged parallel to each other. Such an arrangement proceeds in alignment until it reaches another aggregate attempting to do the same thing, but oriented in a different direction; the interface between these two aggregates is a domain wall. Although such a concept has served many useful purposes, it fails in numerous instances and out of its failures have arisen important new developments in magnetism. An area where the accepted theory fails is always one of interest. The history of physics contains countless instances of this kind. Now this situation has occurred in the field of magnetism with the introduction of a new concept called ferrimagnetism.

The need for a theory of ferrimagnetism has existed for over 2,000 years, but man was unaware of this fact until about the last decade. This is because the first magnetic material discovered by man, namely magnetite, does not obey the simple concept of a magnetic material as described above. When the elementary bar magnets, or more specifically, the divalent and trivalent iron ions in Fe_3O_4 are arranged all parallel to each other, the calculated moment of the magnetic material is much greater than that observed. This fact apparently did not seriously disturb the thinking of physicists until recently when Néel made a logical suggestion, namely, that possibly within a given domain, all of the magnetic ions do not have their magnetic moments arranged parallel to each other. He proposed that a certain amount of "pairing off" or antiparallelism exists, and in such a manner as to leave a resultant magnetization of the correct order of magnitude to account for the experimentally observed facts. This is the essence of ferrimagnetism.[1]

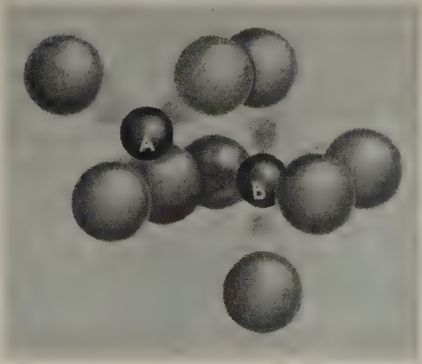


Fig. 1. An artist's conception of a portion of the unit cell illustrating one A site and one B site

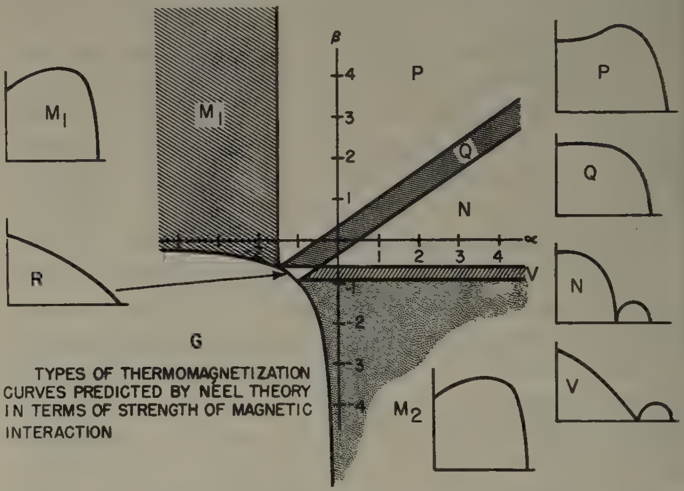


Fig. 3. Correlation between the exchange coefficients and the type of resultant magnetization curve

THE ELEMENTS OF FERRIMAGNETISM

THE BASIC concept of ferrimagnetism requires the existence, within a given domain, of two mutually opposing systems of magnetic ions. This idea was first applied to a series of compounds having a typical crystal structure known as the spinel after a compound by that name. Within a spinel structure there are only two different types of sites where the magnetic ions may be located. By different, is meant different with respect to the number

---

Revised text of a conference paper presented at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954, and recommended for publication by the AIEE Committee on Basic Sciences.

L. R. Maxwell is chief of the Solid State Division, Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

of nearest neighboring oxygen ions. These two places have been named, for simplicity, as the *A* and *B* sites.

The following general formula for a typical system which is frequently called a ferrite will be written; it is sometimes known as a ferrospinel:

$M^{++}O \cdot Fe_2{}^{+++}O_3$

where M^{++} represents a divalent ion which may or may not be magnetic. The way in which the ferrimagnetic state is developed can be understood from the following argument.

Fig. 1 illustrates a portion of a crystal model of the spinel structure where one ion is shown in an *A* site and one in a *B* site; the larger spheres represent the oxygen ions. It will be noticed that the ion in the *B* site has six nearest neighbors, whereas the ion in the *A* site has four. This is a significant difference between the two sites and it is one that plays an important role in the magnetic properties of the material. Fig. 2 illustrates, in principle, the thermal behavior of a ferrimagnet. The intensity of magnetization at saturation has been plotted as a function of the temperature of the material. This situation can be thought of as a combination of two magnetic states functioning in opposition. The ions on the *B* sites give rise to the magnetization shown by the upper curve, while those on the *A* sites contribute to the magnetization given by the lower curve. The resultant or observed magnetization is the curve shown by the heavy line which is the algebraic sum of the two.

One can understand more clearly how the ferrimagnetic state exists through a consideration of the various types of interaction or coupling existing between the magnetic ions. It is believed that the reason that all of the ions on the *A* sites maintain their spin direction parallel to each other is not due so much to the interaction existing between them as to a so-called negative interaction with those ions that are located on the *B* sites. Likewise, the ions on the *B* sites are parallel to each other because of the negative interaction that they feel with respect to the ions on the *A* sites. *A-A* and *B-B* interactions do exist but they are believed to be less important.

These actions can be considered in more detail by defining parameters α and β as follows:

$$\alpha = \frac{\gamma_{AA}}{|\gamma_{AB}|}, \quad \beta = \frac{\gamma_{BB}}{|\gamma_{AB}|}$$

where the coefficient γ gives a measure of the coupling between the magnetic ions on the various sites. The parameters α and β indicate the relative strength of the *A-A* and *B-B* interactions, with respect to the *A-B* interactions. They may be either positive or negative. There is a direct bearing between the type of thermomagnetic curve and the nature of the ionic interactions.

Fig. 3 shows, in the central part of the figure, what is essentially a map containing certain areas within which all of the corresponding values of α and β give rise to a thermomagnetic curve as indicated on the periphery. Unusual types of curves are shown. In addition to a more or less normal one, as illustrated at *Q*, it is possible to have curves where the magnetization increases with increasing temperature such as M_1 and *P* and curves where the magnetization goes to zero and then increases again and returns to zero the second time—a type of curve that might be referred to as a "bouncing" one.

The way the bouncing curve occurs can be seen further in a qualitative way from Fig. 4. Here the variation of the intensity of magnetization with temperature is illustrated as it may occur for the ions on the *B* and *A* sites. The difference in these two gives a resultant which at a certain point goes through zero and to negative values, but then returns to a second zero. An example of this behavior can be found for a material developed by E. W. Gorter and J. A. Schulkes which is a lithium iron chromite ($Li_{0.5}Fe_{1.25}Cr_{1.25}O_4$). The thermomagnetic behavior of this material is shown in Fig. 5. At about 310 K the magnetization approaches zero with a maximum in the neighborhood of 420 K and a second Curie temperature near 480 K. The experiment illustrates the absolute value of the resultant intensity shown in Fig. 4.[2]

It is also possible to set up a system where the resultant

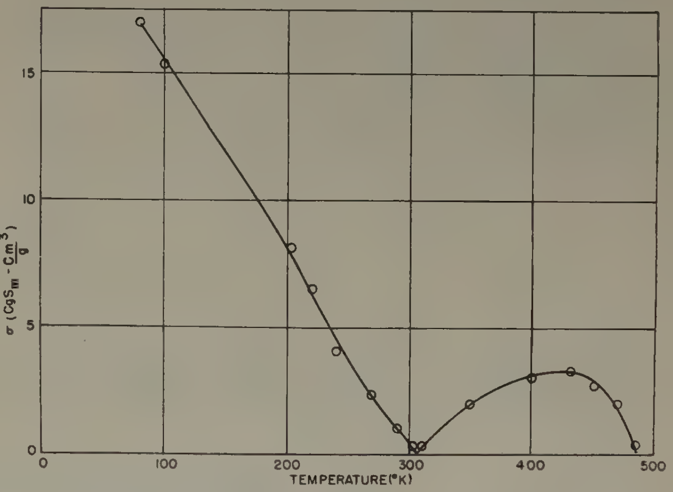


Fig. 5. Behavior of resultant magnetization of a lithium iron chromite ($Li_{0.5}Fe_{1.25}Cr_{1.25}O_4$) with temperature

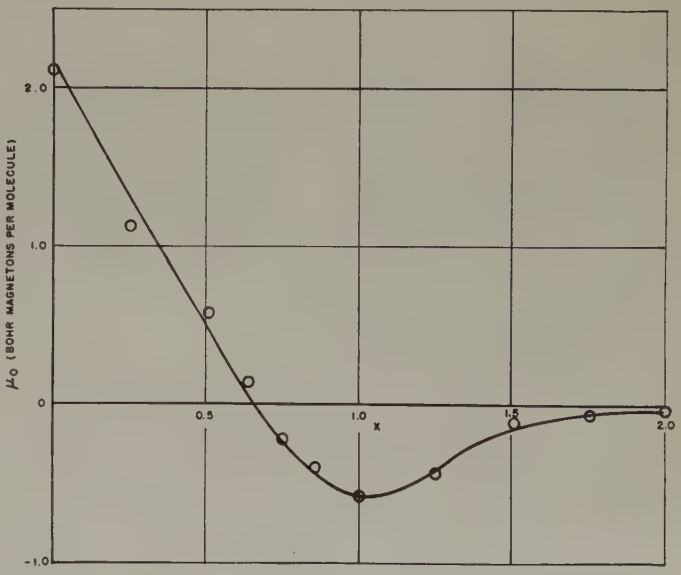


Fig. 6. Behavior of the resultant magnetization for nickel ferrite aluminates ($NiFe_{2-x}Al_xO_4$) as a function of composition

magnetization proceeds through a crossover or compensation point where the composition of the material replaces the temperature parameter. This occurs for a series in which trivalent aluminum is substituted for trivalent iron in nickel ferrite as shown in Fig. 6. The crossover occurs at a point between $x = 0.5$ and $x = 1$, where x is the fractional number of Al^{+++} ions per molecule. At this point the magnetization arising from the A and B sites are equal and opposite.[3]

All of these theoretically predicted thermomagnetization curves have now been realized experimentally.

Fig. 7 illustrates, as a summary, the present types of magnetic states and their relationships to each other; included are ferromagnetism, paramagnetism, ferrimagnetism, and antiferromagnetism.

SUMMARY AND CONCLUSIONS

The greatest opportunity for the use of ferrite materials in industry lies in the use of suitable core material at high frequencies where one is concerned with the motion of domain walls and the rotations within a given domain. These behaviors depend upon the resultant magnetization which has been discussed, as well as other factors, such as crystal anisotropies and magnetostrictive effects.

The failure, thus far, of the ferrites for use in power-type transformers that operate at frequencies of 60 cycles is due to the phenomena of ferrimagnetism. On account of the antiparallel arrangements, the saturation magnetization of the ferrites is always low. As an example, in the case of the nickel ferrite, the saturation magnetization is about 3,000 gauss. If the magnetic ions were coupled ferromagnetically—parallel to each other—the saturation magnetization for this material would be greater than 16,000 gauss equal to or better than some of the best transformer iron. Through the studies of ferrimagnetism it is hoped in the future to secure a clue as to what can be done to obtain a ferrite which is ferromagnetic.

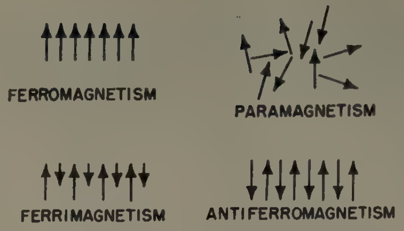


Fig. 7. A schematic representation of present states of magnetism

REFERENCES

1. Propriétés Magnétiques des Ferrites; Ferrimagnétism et Antiferromagnétisme, **Louis Néel.** *Annales de Physique*, Paris, France, vol. 3, 1948, pp. 137–98.

2. Reversal of Spontaneous Magnetization as a Function of Temperature in LiFeCr Spinels, **E. W. Gorter, J. A. Schulkes.** *Physical Review*, New York, N. Y., vol. 90, 1953, p. 487.

3. Magnetization in Nickel Ferrite-Aluminates and Nickel Ferrite-Gallates, **L. R. Maxwell, S. J. Pickart.** *Ibid.*, vol. 92, 1953, pp. 1120–6.

New Electric Device to Detect Leaks of Inflammable Gases

W. C. WHITE
FELLOW AIEE

When alumina contains an alkali metallic salt, it becomes electrically conductive to a varying degree in the presence of a small amount of inflammable gas. This new detector element can detect a leakage rate of combustible gas of about one cubic inch per hour at atmospheric pressure and locate the leak.

A number of devices to detect the presence of inflammable gases in the atmosphere are available.[1] These are useful in indicating the concentration of inflammable and explosive gases in closed spaces. They give a quite accurate quantitative response to the presence of such gases long before they have reached the danger point as an explosive mixture.

These devices, however, are not very suitable for finding the exact location of leaks in pipes, fittings, or tanks; and, of course, such leaks are usually the cause that leads to dangerous concentration of inflammable gases in the air.

A few years ago, a thermionic phenomenon was applied to the technique of leak detection.[2–4] This type of leak detector is one that is selectively sensitive to the halogens or their compounds. It is being used almost universally today in the factory testing of household refrigerators, freezers, water coolers, and air-conditioning units. Freon is the refrigerant in practically all of these appliances, and this compound is rich in the halogen gases fluorine and chlorine. The halogen leak detector measures the flow of positive ions from a red-hot platinum wire to a negative electrode in a stream of air to be tested. When even the slightest trace of halogen or a halogen-compound vapor is in the air stream, the positive-ion emission current is greatly increased. This increase of

Full text of conference paper presented at the AIEE Summer and Pacific General Meeting, Los Angeles, Calif., June 21–25, 1954.

W. C. White is with the Research Laboratory, General Electric Company, Schenectady, N. Y.

current is made evident to the operator of the detector in a variety of ways. The detector is particularly adaptable to finding the location of small leaks, owing to the fact that the air passing through the detecting element is drawn in through a small tube which can be used as a probe to test the air at any point of suspected leakage or over small areas.

With the greatly increased use of natural gas and bottled fuel gases, there is a possible need for a similar device for finding the exact location of small leaks. It is also useful in the case of hydrogen because this gas is relatively expensive as ordinarily used from tanks.

THE NEW GAS-SENSITIVE UNIT

THE GAS-SENSITIVE element to be described operates as a result of an entirely different phenomenon than that taken advantage of in the halogen-vapor detector.

Ceramic materials become electrically conducting to a varying extent as their temperature is raised. For alumina of a high degree of purity, the temperature must be very high, almost a white heat, before this conduction becomes very appreciable. However, when the alumina contains a salt, particularly that of an alkali metal, this electric conductivity, which is electrolytic in its nature, occurs at a much lower temperature. If, during manufacture, the alumina is fired only to a low temperature, say 1,350 C, it will absorb a chemical compound readily from a water solution. A piece of ceramic so treated becomes an ionic solid conductor above 300 C.

In a material of this sort, a variation in electric conductivity occurs along its surface when it is operated in the proper manner and when in the presence of a small amount of inflammable gas in the surrounding air. One of the electrodes in such an arrangement is simply a connection with the body of the ceramic. The other electrode is special in that it is operated at a temperature somewhat above that of the ceramic body. This is accomplished by passing current through a small platinum wire which is tightly wound in a threaded groove on the surface of the ceramic core. Where this hot platinum wire touches the surface of the ceramic, the resistivity of this junction appears to be highly sensitive to small amounts of gas in the surrounding air.

For convenience in design and operation, this hot wire is also used as a source of heat for the ceramic core to maintain it at the correct temperature. A ceramic core wound with the platinum heater wire and with the U-shaped "warm" electrode inserted in one end is shown in Fig. 1.

The phenomenon involved can best be described by reference to Fig. 2. Here, for simplicity, is shown in cross section a single element of platinum heater wire in a groove in the threaded core. A connection is made to the body of the ceramic and this is called the "warm" electrode, in that it is simply a connection. The "hot" electrode is the piece of platinum wire operated below red heat by passing a current through it. The response to inflammable gases seems to take place where the hot platinum wire contacts the ceramic. Here, apparently, a form of barrier junction builds up. Practically the whole interelectrode voltage appears at this barrier junction, but it shows a tendency to "break down" when the surrounding air contains a trace of inflammable gas.

Fig. 1. The ceramic core and electrode structure of the detector element for inflammable gases compared with a paper clip

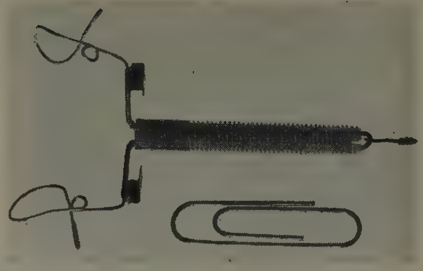
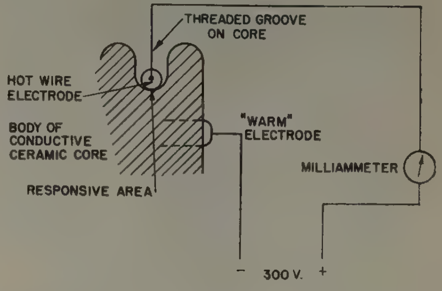


Fig. 2. The essential features of the detector element and how they are electrically connected



STRUCTURAL DESIGN OF THE ELEMENT

THERE IS a very practical reason for building this hydrogen- and gas-sensitive element in the way described, even though undoubtedly other structural designs could be devised to take advantage of this particular phenomenon.

A sensitive element of this sort is a relatively small and inexpensive part of the whole equipment necessary to make a useful leak detector; the circuit components, housing, indicating devices, and other accessories are much larger and more expensive than the element itself. Therefore, an inflammable gas-sensitive element that can be used in existing halogen-detecting equipment is very advantageous. In other words, this new element is made to be as electrically and mechanically interchangeable with the halogen-sensitive element as possible. This completely assembled new element is shown in Fig. 3.

There are only three minor differences between this and the halogen-sensitive element: (1) the alumina core is made an ionic conduction solid; (2) a higher-resistance platinum wire is used, so that the core operates at a lower temperature; and (3) an electric connection has been added between the outside cylindrical electrode and the warm electrode connection to the ceramic piece. In this new element, the outer cylinder is no longer an electrode but is simply used to guide the air flow over the surface of the ceramic core. This cylinder is thus used also as part of the electric connection to the warm electrode.

ELECTRICAL CHARACTERISTICS

AS a d-c circuit component, this element has some of the ionic conduction characteristics of an electrolyte. It polarizes and builds up the equivalent of a counterelectromotive force, but this built-up barrier breaks down intermittently as the voltage is raised above a certain value, which is between 300 and 325 volts for the element described. Apparently, this breakdown voltage is lowered

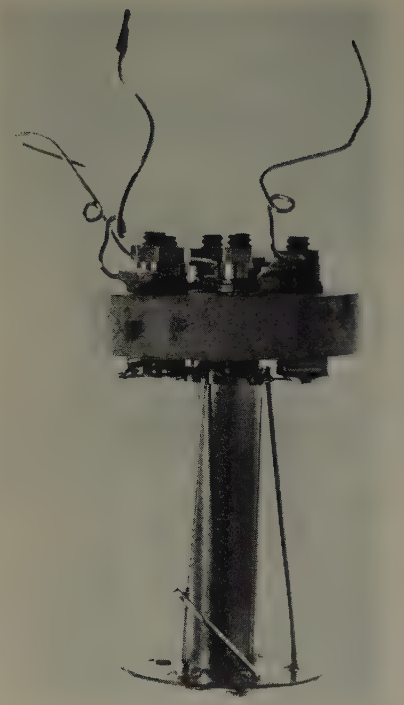


Fig. 3. The assembled detector element for use in leak detector equipment

when the air around the sensitive area of the ceramic core surface contains a combustible gas.

It is necessary, therefore, to maintain the interelectrode operating voltage within a certain range. Again for the device described, the response to a gas-air mixture falls off rapidly as the interelectrode voltage goes below 275 volts. It is erratic and unsatisfactory in operation, owing to abnormally high currents, as this voltage approaches 325 volts. Operation appears most satisfactory when the hot platinum wire operates as the positive electrode.

Observations of the interelectrode current with an oscilloscope show that when the element is exposed to air containing a combustible gas, there is an irregular increase of current similar in nature to that which occurs when the voltage across an electrolytic capacitor approaches the breakdown point. When the d-c interelectrode voltage contains a slight ripple, the increase of current with exposure to gas occurs at the peak of these ripples. Therefore, it is essential for best operation to use a well-smoothed-out d-c voltage supply.

Similar also to the characteristics of an electrolytic capacitor is the element's response to changes in d-c operating voltage. For instance, if the interelectrode voltage is lowered, say from 300 to 285 volts, the immediate response as a gas detector is greatly lowered. However, the polarization effect adjusts itself after a few moments to this lowered voltage and the element quickly regains almost normal response.

In a similar way, a sudden increase of 10 or 15 volts may cause an intermittent breakdown or a false indication, but soon the element adjusts itself to this new voltage and the operation again becomes normal.

The element as now built, therefore, cannot be considered as an instrument giving an absolute indication of the amount of inflammable gas in the air, but rather as a device to detect the presence and location of a leak.

OPERATION

The satisfactory operation of this device is not at all critical to the temperature of the ceramic core and its heater wire. It shows little change with a ±10-per-cent change in normal heater voltage. The rated heater voltage is usually somewhere between 10 and 17 volts.

This element is not sensitive to halogen vapors and should not be used with them, as a heavy dose of such vapors will poison the element and require that it be operated in the air for several hours to return it to normal condition.

This new element is sensitive to hydrogen, natural gas, alcohol vapor, and a number of other inflammable or reducing gases in the air passing through it. As the element operates below a red heat, there should be no danger from igniting inflammable gas-air mixtures under normal operating conditions. The new element is also sensitive to water vapor. This does not introduce any complications when the equipment is used in a high-humidity atmosphere because the response to natural gas and hydrogen is additional to that of water vapor.

The impregnated ceramic core of these gas-sensitive elements absorbs some moisture from the air when not in use; therefore, when first operated, it may show excessive interelectrode current. In a few moments, this returns to normal but again rises as the body of the ceramic core warms up. If it has been standing in moist air for some time, it may then take as long as 15 minutes at rated heater current to dry out the core so that operation is normal.

In searching for small leaks, it is best to remove any dust or small particles from the surfaces being checked, as they sometimes give a false indication.

SENSITIVITY

As has been stated, this device as now built cannot be considered as giving an accurate quantitative response; therefore, it is only possible to give an approximate figure for its sensitivity. The response to hydrogen is such that it is possible to detect a few parts per 10,000 by volume. Expressed in another way, the element is capable of detecting a leakage rate of about one cubic inch per hour at atmospheric pressure.

For combustible gases that are chemical compounds, the sensitivity is somewhat greater and appears to be better the heavier the molecular structure of the gas.

In any leak detector, particularly when first used, it is always convenient to have some easy method of checking its sensitivity to be sure it is operating normally. In this device, a very simple test is to cup the hand around the air intake. Normally there is enough moisture evaporating from the hand to give an indication. In very hot humid weather, this is not satisfactory, but under such a condition the breath can be used in the great majority of cases.

REFERENCES

1. Gas Analysis and Testing of Gaseous Materials, **V. J. Altieri.** American Ga Association, Inc., New York, N. Y., pp. 128–33.

2. Electronics Simulates Sense of Smell, **W. C. White, J. S. Hickey.** *Electronics*, Nev York, N. Y., March 1948.

3. How to Test for Leaks Reliably, Quickly and at Low Cost, **J. R. Neff.** *Genera Electric Review*, Schenectady, N. Y., October 1949, p. 41.

4. Positive-Ion Emission, A Neglected Phenomenon, **W. C. White.** *Proceedings*, Institute of Radio Engineers, New York, N. Y., vol. 38, no. 8, August 1950.

H-V Impulse Tests on Lines and Substations

J. W. SKOOGLUND
ASSOCIATE MEMBER AIEE

W. H. KOLB

T. L. DYER, JR.

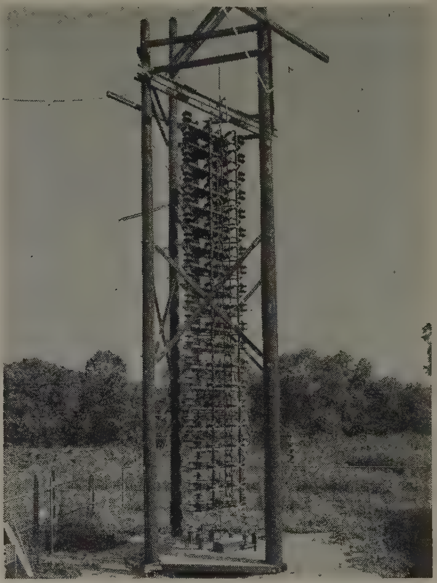


Fig. 1. 2,000-kv suspended surge generator

SINCE AUGUST of 1952 high-voltage surge studies have been in progress at the 500-kv test project sponsored by the American Gas and Electric Company. The test project is located adjacent to the Tidd power plant near Brilliant, Ohio. The surge studies were conducted as a co-operative program between the Westinghouse Electric Corporation and the American Gas and Electric Service Corporation. Westinghouse supplied the surge generator and all necessary measuring equipment; American Gas and Electric erected the high-voltage bus, surge generator, and control building in addition to making the transmission lines available for the tests.

Surges are applied at the ends of the two long lines (7,200 feet) and measurements are made at points along the lines and in the high-voltage substation.[1,2]

A new type of surge generator was used for the tests (see Fig. 1). The entire generator is suspended from steel beams fastened diagonally between four 60-foot wood poles. Twenty capacitor trays are supported by three strings of 10-inch 25,000-pound suspension insulators. A conventional Marx circuit is used in charging and discharging the generator. A motor-operated gap mechanism permits remote operation of the generator through an output range of 400 to 1,800 kv.

At the measuring locations the voltage dividers are suspended from the conductor by means of a block and tackle. Because of the need for measuring fast-front and chopped waves a new type of voltage divider was developed especially for these tests.[3] It is essentially a 15,000-ohm resistance divider with capacitance compensation to overcome the effect of stray capacitance to ground.

Two cathode-ray oscillographs are used during normal test operations. One measures the voltage applied to the transmission lines and another the voltages along the lines or in the substation. Both oscillographs are equipped with cameras to produce a photographic record of each individual surge on a single 4- by 5-inch film sheet. Satisfactory records are obtained at even the fastest time sweep of 0.5 microsecond. The mobile oscillograph, which is used along the lines and in the substation, is mounted in a house-trailer. The oscillograph which measures the applied wave is located in the surge-generator control building.

The electrical length of the test lines is about 7.5 microseconds. If the lines are left open at the substation end, the voltage at intermediate points will be affected by reflections from this discontinuity. Measuring at a position 3,000 feet from the substation, oscillograph records would be useless after approximately 6 microseconds because of the large positive reflection. In order to utilize the full length of the line and obtain true attenuation records, a continuous line was simulated by the addition of a shunt resistor equal to the surge impedance of the surged conductor combination. A commercial carbon resistor was found suitable for this application. The individual resistors are 18 inches long, 1 inch in diameter, and of 36 ohms resistance. To support and connect resistors, wood mounting boards are used to which the resistors are attached with fuse clips.

The one main reason for terminating the transmission line was to eliminate reflections, therefore, this was the criterion for establishing the correct value of terminating resistance. In practice the value of the resistor was varied until a minimum reflection was obtained.

In addition to the high-voltage surge studies a parallel program of attenuation and substation tests was performed with the synchronograph (a low-voltage repetitive surge generator).[4] The synchronograph proved a reliable means for determining attenuation below the conductor corona voltage and for determining substation voltages, even above the corona voltage, when the waveshape of the incoming voltage is known.

REFERENCES

1. High-Voltage Impulse Tests on Transmission Lines, **C. F. Wagner, I. W. Gross, B. L. Lloyd.** AIEE *Power Apparatus and Systems*, April 1954, pp. 196–210.

2. High-Voltage Impulse Tests on Substations, **I. W. Gross, S. B. Griscom, J. M. Clayton, W. S. Price.** *Ibid.*, pp. 210–22.

3. Voltage Divider for Measuring Impulse Voltages on Transmission Lines, **S. B. Griscom, B. L. Lloyd, A. R. Hileman.** *Ibid.*, pp. 228–37.

4. Lightning Problems Solved With the Synchronograph, **E. L. Harder, J. M. Clayton.** *Ibid.*, June 1953, pp. 375–83.

Digest of paper **54-156,** "Measuring Equipment and Techniques Used for High-Voltage Impulse Tests on Lines and Substations," recommended by the AIEE Committees on Transmission and Distribution and Protective Devices and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 18–22, 1954. Published in AIEE *Power Apparatus and Systems*, April 1954, pp. 223–8.

J. W. Skooglund and **T. L. Dyer, Jr.,** are with Westinghouse Electric Corporation, East Pittsburgh, Pa., and **W. H. Kolb** is with American Gas and Electric Service Corporation, New York, N. Y.

Computer Search for Operating a Hydro System

R. J. CYPSER
ASSOCIATE MEMBER AIEE

IN SOME INDUSTRIES, the allocation of production among plants, so as to achieve maximum over-all economy, requires the consideration of seasonal variations in the availability of raw materials and product demand, and the recognition of progressive changes in production efficiency depending on past levels of production. Such is the case in a combined hydro-thermal electric system where cumulative changes in water storage elevations materially affect plant efficiencies.

It is found that realistic descriptions of such a system involve relations that are not linear and are not entirely analytic. Moreover, to obtain practical results, it is necessary to place boundaries on the allowable modes of operation because of technical and social limitations. Such system descriptions can easily be handled by a digital computer.

The cost gradient can be evaluated to provide corrections to a proposed mode of operation, giving the largest possible cost reduction for a given size of change in the variables which determine production level. Hence the role of the computer is chosen to be a search for more economic operation by following the path of steepest cost descent.

The annual cost in the type of system being discussed is expressible in the form:

$$\$ = \int_0^T \$/\mathrm{hr}(L(t),F(t),S(t),\dot{S}(t))dt \tag{1}$$

where

$L(t)$ = total product-demand schedule (system load in the hydro-thermal system)
$F(t)$ = a set of schedules of availability of raw materials (stream flows and fuel costs in the hydro-thermal system)
$S(t)$ = a set of schedules of control variables (water storage in the hydro system)
$\dot{S}(t)$ = time derivatives of $S(t)$ which, together with $S(t)$ and $F(t)$, set the production levels at each plant.

It can be shown that the components of the gradient of such an annual cost are proportional to the Euler equations for the integrand. That is, for each S_i at each time t_k, the corresponding component of the gradient is

$$\frac{\partial \$}{\partial S_i(t_k)} = \frac{\partial \$/\mathrm{hr}(t_k)}{\partial S_i(t_k)} - \frac{d}{dt}\sum \frac{\partial \$/\mathrm{hr}(t_k+\tau_{ib})}{\partial \dot{S}_i(t_k)} \tag{2}$$

The summation is needed to allow for the fact that change in the production level at one plant may affect the efficienc or production levels at other plants as well. This is the cas when more than one hydro plant is located on the sam stream.

To follow the path of steepest descent, the compute program must make corrections to the control variables a each plant, at sample times throughout the time interval, i proportion to the values of their corresponding Euler expressions. Hence the computer must recycle through program for evaluating the Euler equation, using differen parameters for each plant and different values of input an control variables for each time selected.

Experiments were carried out on the WWI digital computer at Massachusetts Institute of Technology (MIT) t demonstrate (*a*) that a series of orderly, well-behaved improvements in operating economy could be carried out b a computer with little manual intervention, and (*b*) tha such modifications could be made to respect operatin limitations such as minimum allowable storage drawdown and that in the event a proposed schedule should violat rules of operation, the degree of violation will be successivel reduced.

Some 73 small modifications to a proposed mode o operation of a model of a 3-plant hydro-thermal systen produced successive reductions in operating cost that wer steady, well-behaved, and approaching a point of diminishing returns. The annual effective operating cost wa reduced about 10 per cent. Roughly one half of this was reduction in fuel costs; the remainder was a reduction o penalty costs for violation of an operating rule. Th respecting of operating limitations was demonstrated by th adherence to a limit on allowable drawdown, in spite o the fact that both increased generation and a reduction o the violation of operating rules could otherwise have bee obtained.

Because the gradient approach is a cautious, step-by-ste searching along a path of steepest descent, a large number o steps may be required before a point of diminishing return is reached.

The computing time increases almost linearly with th number of plants and with the sampling frequency if th time for flow between plants is neglected. Then, in orde to complete the computations at, say, 50 samplings at eac of 5 plants, in 10 seconds, a computer speed of about 15,00 operations per second is needed. In high-speed compute time is often also needed to transfer data periodically to storage medium with very high capacity but longer acce time. If, for example, magnetic drum storage is so use data transfers require roughly 20 milliseconds. Allowin two transfers per sampling, then, the 250 samplings woul require 15,000 operations per second if one complete iteration were to be finished in 20 seconds.

Digest of paper 54-277, "Computer Search for Economical Operation of a Hydro-Thermal Electric System," recommended by the AIEE Committees on System Engineering and Protective Devices and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer and Pacific General Meeting, Los Angeles, Calif., June 21–25, 1954. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1954.

R. J. Cypser is with the International Business Machines Corporation, Poughkeepsie, N. Y.

The material described in this article represents some of the results obtained as part of a doctoral research program conducted by the author at MIT. The aid of Professors E. W. Boehne, G. S. Brown, A. E. Fitzgerald, William Pease, and William Linville are gratefully acknowledged. Credit also is due the Digital Computer Laboratory of MIT, the Bonneville Power Administration (BPA), who supported this work, and B. V. Hoard and W. Whitbeck of BPA who contributed to the formulation of the problem.

Energy Storage Methods for Two Hydro Plants

B. V. HOARD
MEMBER AIEE

WHEN TWO or more hydroelectric storage plants are located on a river so that storage from upstream reservoirs will be used through downstream plants, certain methods of storage withdrawal will produce more energy as needed by the load than others. As the net head drops due to storage withdrawal at any plant, all natural flow water as well as remaining upstream reservoir storage then must be used at some lower averaged head, until refill is made later during a period of high river flow. Only incremental energy obtainable from storage withdrawal is used here for comparison of various methods and five components of incremental energy (ΔE) are obtained for each method. Three components are positive; plant *1* storage through plant *1*, plant *2* storage through plant *2*, plant *1* storage through plant *2;* two components are negative; plant *1* natural flow through plant *1*, and plant *2* natural flow through plant *2*. The last two are obtained due to drops in head and from the total natural flow passing during the period of reduced head.

Methods of storage withdrawal from two plants are defined on Table I with a glossary of terms used. Differences of incremental energy designated as $\Delta E(\ )$ - $\Delta E(\ )$ between any two methods of withdrawal are compared and results are summarized on Table II as "Preference Solutions."

The difference in incremental energy obtained by comparison of any two methods of storage use may be represented by the three general terms on the right of the following equation.

$$\Delta E(\ )-\Delta E(\ )=(V\Delta h_2)U_1\pm(W\Delta h_2)f_2T_0-(X\Delta h_1)f_1T_0$$

In this equation U_1, (f_2T_0), and (f_1T_0) each represent quantities of water as indicated in the glossary of Table I. These quantities while variables must be identical when comparing any two methods. The quantities $(V\Delta h_2)$, $(W\Delta h_2)$, and $(X\Delta h_1)$ each represent differences in integrated changes in head as determined from the two methods of storage withdrawal. The products of these terms represent energy gained or lost.

The six columns of preference solutions on Table II are arranged assuming for the left column a relatively small value of $f_1T_0\Delta h_1$ (incremental energy) compared to $U_1\Delta h_2$ and $f_2T_0\Delta h_2$ while for the preference solutions in the right column relatively large values for $f_1T_0\Delta h_1$ are assumed. Limiting factors at each plant for which preference solutions in intermediate columns hold are specified at the top of Table II. It will be observed that as long as the $f_1T_0\Delta h_1$ quantity is relatively small, the *A* method of withdrawal is preferable. This condition may be met either because the change in head is small at plant *1* or because the total amount of natural flow water to be used with decreased head is small. The foregoing development may be applied also to storage plants on separate rivers. Only four columns of preference solutions result.

TABLE I. TYPES OF STORAGE WITHDRAWAL CONSIDERED-TWO PLANTS IN SERIES.

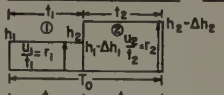
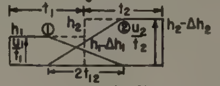
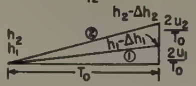
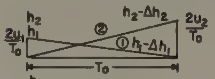
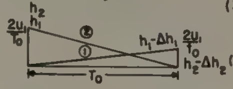
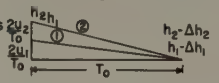
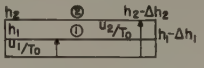
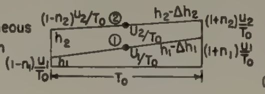
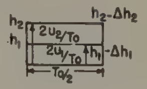
Solution Designation & Type of Withdrawal		Figure showing rates of Withdrawal	Figure No.	Glossary
A	Rectangular-Sequential Plant 1 thru t_1 Plant 2 thru t_2	 t_1 t_2 h_1 h_2 ① ② $\frac{u_1}{t_1}=r_1$ $h_1-\Delta h_1$ $\frac{u_2}{t_2}=r_2$ $h_2-\Delta h_2$ T_0	(1)	T_0 storage period considered t_1, t_2, t_{12} portions of storage period
I	Rectangular-Sequential with variable triangular-simultaneous	 t_1 t_2 h_1 h_2 ① ② $\frac{u_1}{t_1}$ $h_1-\Delta h_1$ $\frac{u_2}{t_2}$ $h_2-\Delta h_2$ $2t_{12}$	(2)	h_1, h_2, heads at maximum storage
B	Triangular-Simultaneous Plant 1 Slope (+1) Plant 2 Slope (+1)	 h_2 h_1 $h_2-\Delta h_2$ ② $h_1-\Delta h_1$ ① $\frac{2u_2}{T_0}$ $\frac{2u_1}{T_0}$ T_0	(3-a)	$h_1-\Delta h_1, h_2-\Delta h_2$ minimum head at minimum storage
C	Triangular-Simultaneous Plant 1 Slope (-1) Plant 2 Slope (+1)	 h_2 h_1 $\frac{2u_1}{T_0}$ $h_2-\Delta h_2$ ② ① $h_1-\Delta h_1$ $\frac{2u_2}{T_0}$ T_0	(3-b)	b_1, b_2, per unit drop in head $b_1h_1=\Delta h_1$ $b_2h_2=\Delta h_2$
D	Triangular-Simultaneous Plant 1 Slope (+1) Plant 2 Slope (-1)	 h_2 h_1 $\frac{2u_1}{T_0}$ ② ① $h_1-\Delta h_1$ $\frac{2u_1}{T_0}$ $h_2-\Delta h_2$ T_0	(3-c)	U_1, U_2 total storage to be used.
E	Triangular-Simultaneous Plant 1 Slope (-1) Plant 2 Slope (-1)	 h_2 h_1 $\frac{2u_2}{T_0}$ $\frac{2u_1}{T_0}$ ① ② $h_2-\Delta h_2$ $h_1-\Delta h_1$ T_0	(3-d)	r_1, r_2 Time rate of storage use.
F	Rectangular-Simultaneous Plant 1 Slope 0 Plant 2 Slope 0	 h_2 ② $h_2-\Delta h_2$ h_1 ① u_2/T_0 $h_1-\Delta h_1$ u_1/T_0	(4)	f_1, f_2 Time rate of natural flow average over period
G	Trapezodial-Simultaneous Postive slopes shown $(-1)<n_1, n_2<(+1)$	 $(1-n_2)u_2/T_0$ ② $h_2-\Delta h_2$ $(1+n_2)\frac{u_2}{T_0}$ h_2 ① u_2/T_0 $h_1-\Delta h_1$ $(1+n_1)\frac{u_1}{T_0}$ $(1-n_1)\frac{u_1}{T_0}$ h_1 u_1/T_0 T_0	(5)	$n_1\ n_2$ per unit slope of rate of withdrawal $\Delta E_1+\Delta E_2=\Delta E(\ )$ Incremental energy
H	Rectangular-Simultaneous in one half total time period	 h_2 h_1 $h_2-\Delta h_2$ $2u_2/T_0$ $2u_1/T_0$ $h_1-\Delta h_1$ $T_0/2$	(6)	$\Delta E(A)-\Delta E(B)$=difference in incremental energy obtained on comparison of two methods of storage-use.

TABLE II PREFERENCE SOLUTIONS AND THEIR LIMITS FOR VARIOUS METHODS OF STORAGE-USE. TWO PLANTS IN SERIES

When $f_1T_0\Delta h_1$ lies between, or is greater, or is less, than the specific limits as given below, the series of preference solutions specified are obtained. A higher position in any column indicates greater ΔE. Smallest value of $f_1T_0\Delta h_1$ required for solutions on left, a highest value for solutions on right.

$f_1T_0\Delta h_1<$	$\frac{4}{5}u_1\Delta h_2-\frac{1}{5}f_2T_0\Delta h_2$	Btwn	$u_1\Delta h_2$	Btwn	$\frac{6}{5}u_1\Delta h_2+\frac{1}{5}f_2T_0\Delta h_2$	Btwn	$2u_1\Delta h_2+f_2T_0\Delta h_2$	Btwn	$6u_1\Delta h_2+5f_2T_0\Delta h_2$	$<f_1T_0\Delta h_1$
A		A		H		H		H		H
C		H		A		B		B		B
H		C		B		A		D		D
B		B		C		C		F		F
F		F		F		F		C		C
E		E		D		D		A		E
D		D		E		E		E		A

It is felt that the results obtained from this investigation will be of value as a general guide to those who must consider storage water withdrawal from two or more reservoirs and attempt to get the maximum useful energy consistent with system load deficiencies and the many system limitations to be considered.

Digest of paper 54-259, "Analysis of Methods of Storage Use to Obtain Maximum Incremental Energy From Two Hydro Storage Plants," recommended by the AIEE Committee on System Engineering and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer and Pacific General Meeting, Los Angeles, Calif., June 21–25, 1954. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1954.

B. V. Hoard is with the Bonneville Power Administration, Portland, Oreg.

Effect of Electric Discharges on the Breakdown of Solid Insulation

T. W. DAKIN
ASSOCIATE MEMBER AIEE

H. M. PHILOFSKY
ASSOCIATE MEMBER AIEE

W. C. DIVENS

A number of the factors affecting the breakdown of dielectrics with corona are outlined and a description of the variation of a-c dielectric strength with time of voltage application for a variety of dielectrics is presented.

THE PRESENCE of corona at the surface of electrical insulation has long been recognized[1] as a possibly damaging situation. An attempt is usually made by electric apparatus designers to avoid corona at operating voltages or to minimize it. This is done by impregnation with liquids, waxes, or resins, or by grading the stress away from edges where corona would occur. Sometimes it is done with the primary purpose of eliminating radio interference rather than protecting the insulation.

Corona is a very appreciable factor in affecting the dielectric strength of solid insulation as it is measured in practical tests. This is true because intense corona occurs at electrode edges previous to the breakdown of the solid, unless considerable care is taken to avoid it. The corona is very apparent with a-c breakdown tests in air. Corona also occurs and may be even more serious in the case of breakdown tests in mineral oil, although it may not be so apparent.

Corona can be described as a partial breakdown of insulation due to concentration of electrical stress in divergent electric fields at sharp edges, fine wires, etc., or due to increased stress or lower dielectric strength (or both) in one component of different insulating materials in series. A common situation is a series air gap which is subject to a higher electric stress in proportion to the dielectric constant of the solid in series with it. The dielectric strength of the air gap is also lower than that of the solid. Both factors lead to initial breakdown of the air gap at voltages considerably below those required to puncture the solid. Such air gaps occur in porous or incompletel impregnated insulation, at th surface of insulation unde conductors, or at edges c electrodes or conductors i contact with insulation. Similar gaps in oil in series with solid dielectric also ma break down initially before the solid fails. Corona o discharge starting voltages in oil are usually much highe than in air of course, due to the higher dielectric constan and strength of the oil. Breakdown of such series gaps i air, or oil, may produce higher stresses on the solid an also erode the surface of the solid reducing its thickness, i time, to such a value that puncture occurs.

Corona is probably the most important factor in decreasing the dielectric strength of solids with time c alternating voltage application, but it is not the intentio of this article to imply that it is the only factor. Dielectri heating due to a-c conductivity is with some materials th major factor in determining the long-time a-c dielectri strength of solid dielectrics.

MINIMUM CORONA VOLTAGES IN AIR

THE THRESHOLD voltage for corona is of course th minimum voltage at which it can affect the soli insulation. Corona at the surface of isolated conductor away from dielectric surfaces is only of secondary effec

Abridged text of paper 54-70, "Effect of Electric Discharges on the Breakdown of Soli Insulation," recommended by the AIEE Committee on Basic Sciences and approve by the AIEE Committee on Technical Operations for presentation at the AIEE Wint General Meeting, New York, N. Y., January 18–22, 1954. Scheduled for publicatio in AIEE *Communication and Electronics*, 1954.

T. W. Dakin, H. M. Philofsky, and **W. C. Divens** are with the Westinghouse Electr Corporation, East Pittsburgh, Pa.

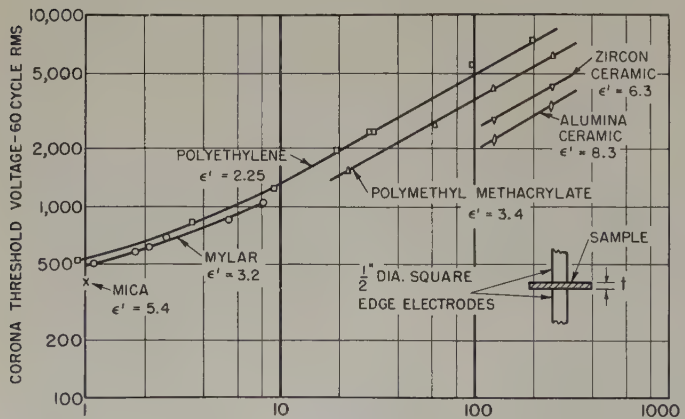


Fig. 1. Corona threshold voltages on dielectric surfaces

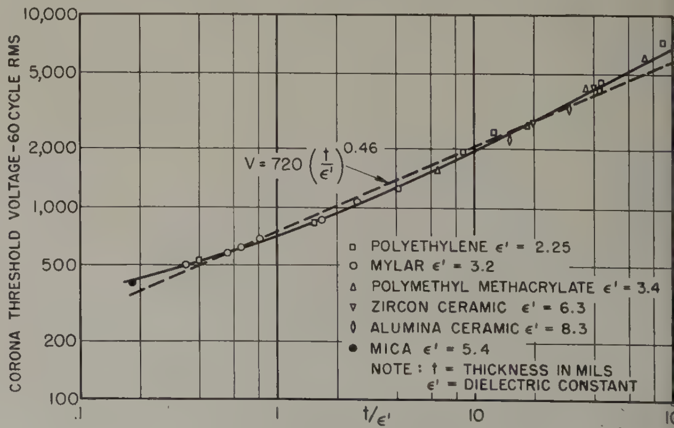


Fig. 2. Corona threshold voltages on dielectric surfaces as function of thickness/dielectric constant

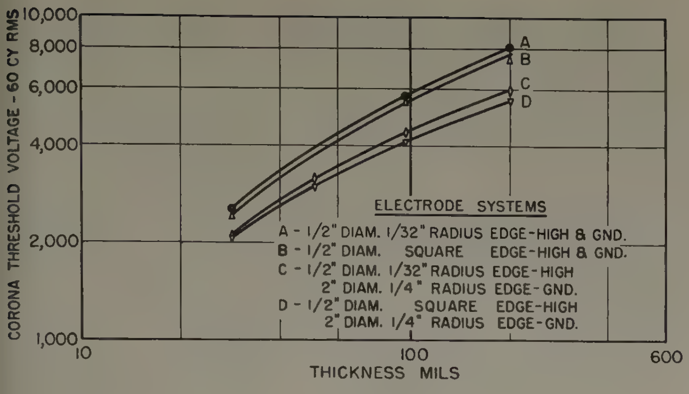


Fig. 3. **Corona threshold voltages on polyethylene**

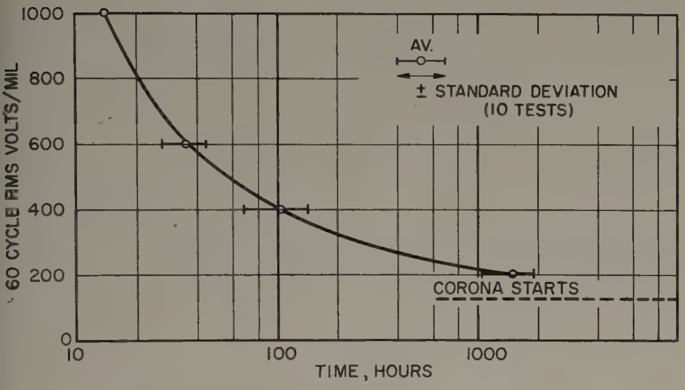


Fig. 4. **Voltage endurance: 5-mil nylon**

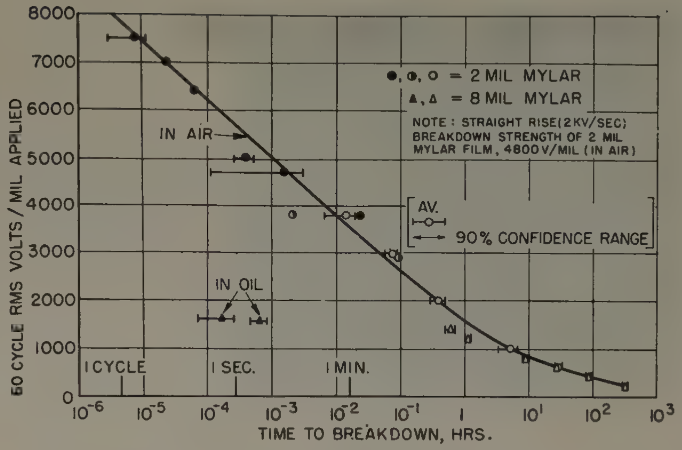


Fig. 5. **Voltage endurance: Mylar film**

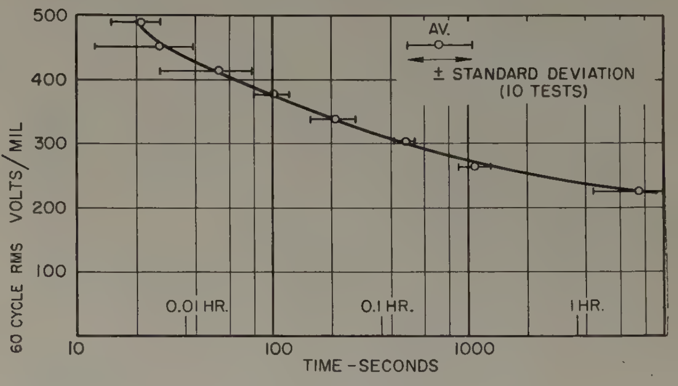


Fig. 6. **Voltage endurance: 133-mil glass melamine laminate**

on the insulation. It may produce ozone or oxides of nitrogen which diffuse to nearby insulation attacking it chemically. This article will not be concerned with such secondary attack, but will be concerned only with corona occurring directly between the dielectric and a conductor or between two dielectric surfaces with, in every case, an appreciable component of the electric field normal to the dielectric surface.

Corona threshold voltages in air are determined by the electric field, the pressure of the air, and the thickness of the gap (Paschen's Law). In Fig. 1 are shown the corona threshold voltages for an electrode system consisting of two 1/2-inch-diameter square-edge electrodes on opposite sides of a plane sheet of insulation. Since the electric field in the air at the electrode edges should be proportional to the dielectric constant of the solid dielectric, the corona threshold voltage should be a function of the ratio of the dielectric thickness to the dielectric constant. That this is approximately so, is demonstrated in Fig. 2, where the data obtained on a variety of insulating materials as shown in Fig. 1 over a range of thicknesses from 1 to 250 mils fall almost on a single line when plotted as a function of t/ϵ'. The dielectric constants of these materials range from 2.25 for polyethylene to 8.3 for the alumina ceramic. The effect of various electrode shapes on the corona starting voltage is demonstrated in Fig. 3 for a single material, polyethylene. By reference to the principle shown in Fig. 2, it is possible to estimate the threshold voltage for other materials with electrodes similar to those of Fig. 3.

The data of Figs. 1 to 3 represent corona "offset" voltages at 74 cm of mercury air pressure. The offset voltage is the voltage at which corona, once started, ceases as the voltage is lowered slowly. This is considered a more consistent and reliable measurement than the "onset" voltage. The offset voltage is usually a little lower than the onset. The difference is greater with lower pressures and larger electrode spacings.

In Fig. 3, it can be noted that the corona threshold voltage decreases as the divergence of the electric field is increased by increasing the dissymmetry of the electrodes. The variations of threshold voltage with the different electrodes of Fig. 3 are about what one would expect from a consideration of the relative electric field intensity at the electrode edge.

RELATION OF BREAKDOWN TIME TO VOLTAGE GRADIENT

THE DEPENDENCE of the dielectric strength on the time of voltage application has been studied by a number of investigators[2–7] some of whom have developed empirical equations for this dependence. However, the relation of the voltage endurance of insulation to corona has not always been appreciated. Recently, Brodhun and Perkins[8,9] have re-emphasized the importance of corona and pointed out that all organic materials are susceptible to corona erosion.

An example of the relation of dielectric strength to breakdown time is given in Fig. 4 for a 5-mil nylon film. The

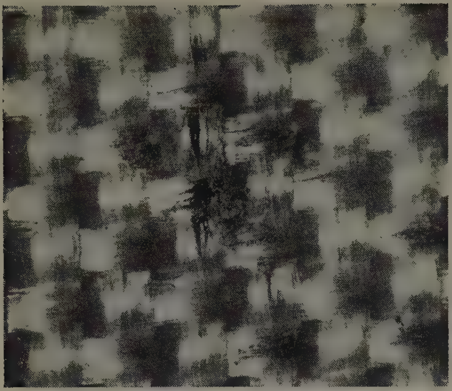


Fig. 7. Corona pit in glass melamine laminate

dielectric strength decreases steadily with increasing time of voltage application, but appears to approach asymptotically the gradient at which corona starts, for very long times of voltage application.

The data plotted in Fig. 4 and in most of the other curves in this article, with the exceptions noted, were determined with a very simple electrode system: a 1/2-inch cylindrical brass electrode, with flat end and square edge opposite a large plane electrode.

This test procedure applied the voltage discontinuously. It was determined in a number of tests that discontinuous application of voltage in the longer time tests resulted in the same breakdown times as continuous voltage application. It also should be noted that conventional dielectric strength step tests, where the voltage is increased in intervals, being held for specified times at each interval until failure occurs, give about the same information as the procedure used here. The step test, however, is believed to be less accurate, since some corona deterioration occurs at lower steps and the time of failure at the terminal step often is not recorded.

The voltage gradient, which is the ordinate of Fig. 4 and later figures and often is referred to throughout the article, is the average gradient, the ratio of the applied voltage to the electrode separation (usually the thickness of the dielectric under test).

The decreasing dielectric strength with time of alternating voltage application begins at the first cycle, and is shown in Fig. 5 for the case of 2-mil Mylar (polyethylene terephthalate) film. For this material the dielectric strength has been measured over a range of times of voltage application of almost 10^8. All of these tests were made in air. To determine the failure times of about a minute or less, the voltage was applied to the samples with a high-voltage switch from an energized transformer and the time of voltage application measured with a recorder capable of recording a 60-cycle wave. The high-voltage switch technique was necessary to avoid the overvoltage surge often noted when switching was done in the primary.

Immersing the solid insulation in oil appears to decrease the time to failure very greatly unless the sample is vacuum treated. This is illustrated by the solid triangles of Fig. 5 for 8-mil Mylar. These tests were made by simply immersing the Mylar film in oil. The oil appeared to wet the film well, but there must have been microscopic air bubbles or an invisible air film left. When the immersed insulation was thoroughly vacuum treated, the times to failure were longer. However such tests were sometimes erratically short, possibly as a result of air bubbles retained on the electrodes from previous tests, as the electrodes were not vacuum treated between tests on the film. The short times to failure in oil must be due to concentration of the corona at microscopic air bubbles. Even in the absence of bubbles initially it is probable that, if the dielectric strength of the oil is exceeded locally, the local breakdown of the oil will produce gas, forming bubbles.

In Fig. 6 are illustrated data obtained on a thick glass melamine laminate tested in oil. It should be noted that the times to failure here are very short for rather low gradients compared to the times to failure of the Mylar and nylon films tested in air. Very likely the concentration of corona at microscopic surface bubbles accelerated the failure as it did in the case of the Mylar immersed in oil. It is possible that corona in microscopic internal voids in this laminate also speeded the breakdown. Skow and Belsterling[10] have published data on the voltage endurance of a number of other laminates tested in oil. They did not discuss the reason for the decreasing dielectric strength with time, but it probably was due to corona.

The possibility of breakdown due to thermal rise (dielectric heating) in the case of the melamine laminate was considered, since such failure might show a similar time effect. It was discarded when it was found that intermittent application of voltage, with long periods of rest between, produced failure in almost the same cumulated time as continuous application of voltage. Furthermore, an examination of the surface of samples which had been exposed to voltage for several minutes, but had not yet failed, showed erosion pits such as is illustrated in Fig. 7. This microscope photograph of a laminate surface shows the rapid and permanent damage produced by corona, under oil in this case.

It is not necessary that the corona be from a metal electrode, as is shown in Fig. 8 where the corona occurred between the surfaces of the enamel on twisted pairs of number 16 enameled wire. The time to breakdown in this case is quite comparable for the same average voltage gradient to the time to breakdown for the nylon and Mylar films with metal electrodes. The wire enamel is a phenolic-modified polyvinyl formal resin.

An examination of the cross section of one of the enameled wires, shown in Fig. 9, after breakdown, illustrates that the average erosion is about 30 per cent of the thickness. At points it must exceed this to a depth sufficient such that the dielectric strength of the remaining film is exceeded. A careful examination of the dark ring, which is the enamel in Fig. 9, shows that erosion is a maximum at two points (indicated by the arrows) away from the point of contact of the two round wires (indicated by the line).

VOLTAGE ENDURANCE AND CORONA INTENSITY

If the decreasing dielectric strength with time of voltage application is due to corona, it can be expected that the time to failure would be related inversely to the corona intensity. The approximate parallel between the time to failure and the reciprocal corona intensity is shown in

Fig. 10 for nylon film. The corona intensity measured here is proportional to the voltage amplitude and the number per second of corona discharge pulses. It was obtained using a wide-band amplifier with an output meter which had a long time constant.

An important factor affecting the corona discharge repetition rate is the frequency of alternation of the voltage. With direct voltage, a corona discharge streamer in series with a dielectric surface charges the surface to a voltage which prevents further discharge streamers from occurring until the applied voltage increases further, decreases, or reverses, or until the surface charge leaks off by surface or volume conductivity. Thus, with a steady direct voltage, corona discharges appear very intermittently. It was determined that in the case of a solid nonporous sheet of dielectric, electrode-edge corona in air with direct voltage was less by a factor as much as 10^5 than with 60-cycle voltage of equal crest value. In fact, the d-c corona discharges came at such a low rate the output intensity meter time constant was not long enough to record a steady reading.

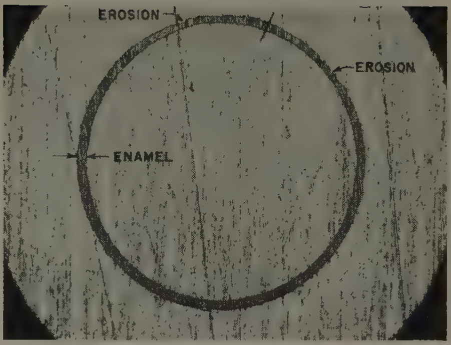
If the corona discharge rate is limited by surface charges, then increasing the frequency of voltage alternation will increase the repetition rate of discharges and correspondingly the rate of attack on the insulation. British authors[11–13] have done a thorough investigation of corona discharges with internal voids, especially in polyethylene cable. They find that the life of cables which have discharges is inversely proportional to the frequency of the applied voltage. How big a factor the corona is compared to dielectric heating in higher frequency breakdown needs further study.

THE EFFECT OF DIELECTRIC THICKNESS ON TIME TO FAILURE

In Fig. 11, tests on nylon film show that at the same voltage gradient the thickness has less effect on the time to breakdown at the higher gradients. The relatively small variation of time to breakdown with thickness for the same voltage gradient is also shown in Fig. 5 where 2- and 8-mil Mylar films are compared at average gradients of 600 volts per mil and above.

Tests have been made on polyethylene at thicknesses from 4 to 30 mils, each at the same gradient of 600 volts per mil. Over this wider range of thickness, the time to breakdown did not vary appreciably.

Fig. 9. Cross section of enameled wire showing corona erosion



A test on a 125-mil polyester-styrene polymer sheet at 240 volts per mil produced failure in 1,007 hours. It can be estimated from data on thinner sheets that a 5-mil film of this material would have failed in about 600 hours at this same gradient. This comparison shows even less dependence of the breakdown time on the thickness for the same applied gradient than is indicated by Fig. 11. An illustration of this polymer sheet after failure is shown in Fig. 12. Deep etching by the corona radiates away from the electrode edge with little evidence of carbonization except at the breakdown hole.

DEPENDENCE OF VOLTAGE ENDURANCE ON MATERIALS AND THE MECHANISM OF BREAKDOWN

To compare the voltage endurance of different materials, it is necessary that they be tested at the same voltage gradient and preferably also the same thickness, although the latter factor appears to be less critical. An examination of Table I will show that all of the plastic materials have about the same order of voltage endurance with the exception of the fluorinated polymers, Kel F and Teflon. At least two of the resin-impregnated mica papers appear to be much more resistant to corona than the resins alone, and the mica splittings are very superior.

In the case of the mica papers, it seems that the mica flakes protect the resin beneath from the corona bombardment and give in some cases a large measure of improvement in the corona resistance. Another example of the protective effect of an inorganic filler on the corona resistance is found in silicone rubber, some data for which

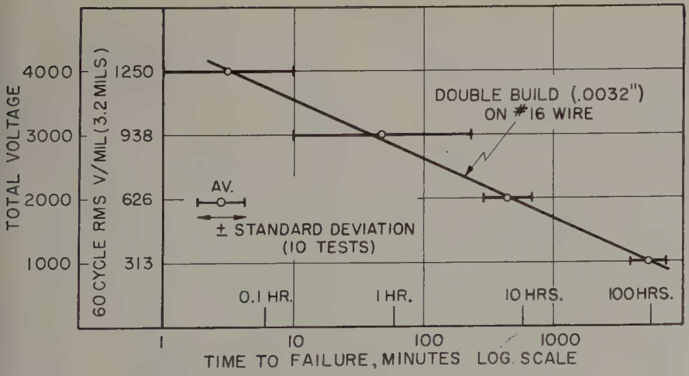


Fig. 8. Corona breakdown of wire enamel between a twisted pair of wires

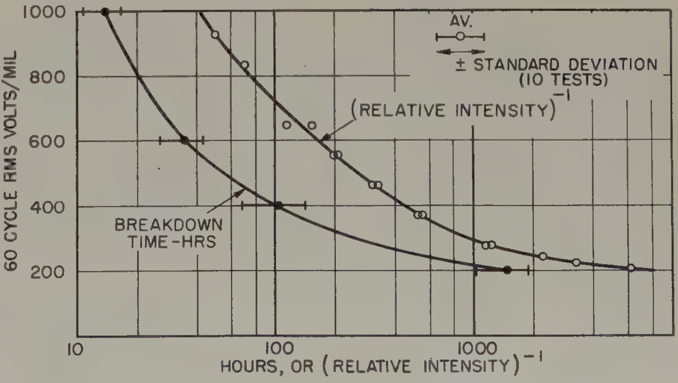


Fig. 10. Corona intensity and time to breakdown: 5-mil nylon

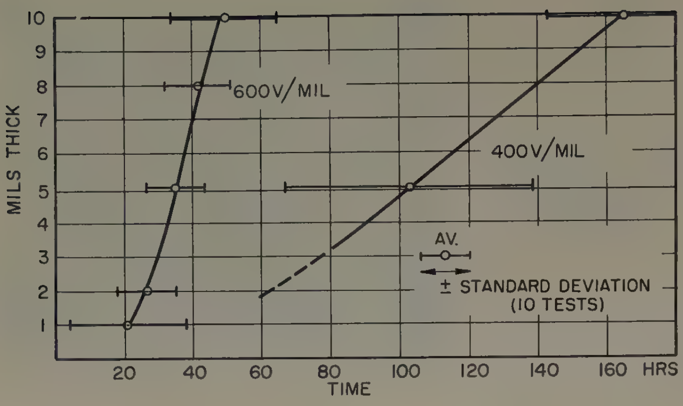


Fig. 11. Voltage endurance: nylon film

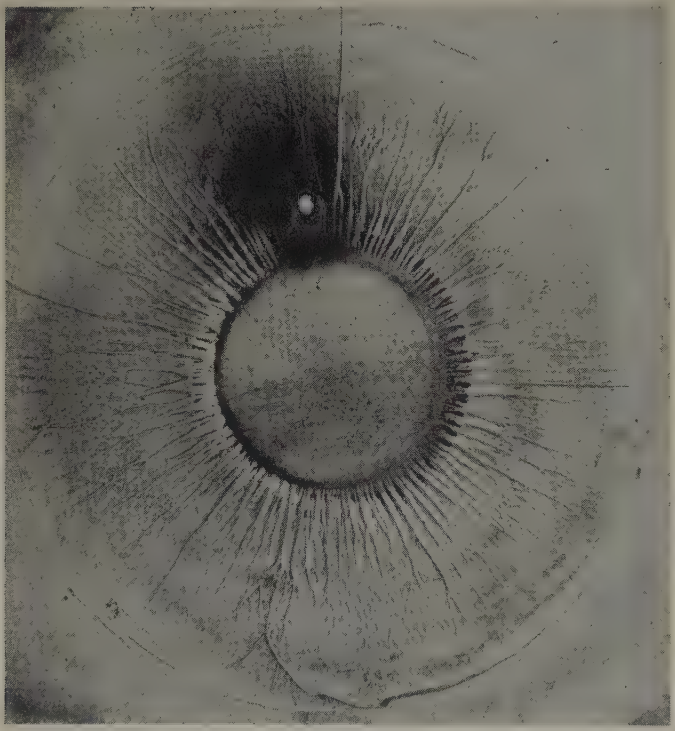


Fig. 12. Corona erosion breakdown: 1/8-inch plastic sheet

are shown in Table II. Comparative data also are given for an unfilled resin coated, by dipping, onto a glass cloth. It can be seen that the unfilled silicone resin is only a little better, if any, than the other organic resins in Table I, with the exception of the fluorinated resins. The glass cloth may give slight protection to the resin. Some tests on the silicone rubbers show very long times to failure. Unfortunately, the thinner samples for which tests are shown here have low average times to failure. A few tests which have lasted very long without failure indicate the high intrinsic corona resistance possessed by this material with the inorganic (silica) filler.

The wide dispersion of the test results obtained with the silicone rubbers and also with the mica papers illustrates the importance of defects in determining the voltage endurance. The voltage endurance appears to be affected by defects in much the same way as the dielectric strength, showing lower times to failure with larger electrodes. If there is a point within the area covered by the corona which is weaker in dielectric strength or in resistance to corona, the corona streamers will seek it out and erode through at that point. Filled materials which derive their corona resistance from the filler, such as the silicone rubber and the mica papers, are much more likely to have these weak points since the filler is susceptible to nonuniform dispersion. Furthermore, threads or filaments of other organic material (dust, for example) if present in the material, easily can form paths of low resistance to corona nearly through the material. Thicker sheets of the silicone rubber are likely to be uniformly better, since it is less likely that a defect or impurity would be large enough to penetrate a large proportion of the thickness.

Table I. Comparison of the Voltage Endurance of Film Materials in the Presence of Corona

Materia	Thickness, Mils	Volts/Mil	Hrs. to Breakdown Average	Hrs. to Breakdown Standard Deviation
Polyethylene	4.4	600	53	20
Mylar	8.4	600	27.2	8
Polystyrene	5	600	74	22
Nylon	5	600	36	7
Silicone*	6.5	615	74	46
Polyester-Styrene Resin	5	583	33	12
Kel F	5	600	7.1	2.3
Teflon	5	600	5.7	4.3
Mica paper A†	5.2	577	4,100	750
Mica paper B†	5.2	577	109	40
Mica paper C†	6.0	510	1,218	383
Mica splittings	1	1,000	>1,500	no failure
Mica splittings	1	2,000	572	519

* General Electric *81132* on 4-mil glass cloth

† Experimental 3-sheet laminates vacuum impregnated with organic solventless thermosetting resin

Table II. Voltage Endurance, Silicones in Presence of Corona

Silicone Rubbers	Thickness, Mils	Volts/Mil	No. Tests	Time to Failure, Hrs. Average	Time to Failure, Hrs. Range
1‡	9	324	5	324	(50, 157, 365, 525, 525)
2‡	8	400	5		(62, 80, 91, 181, >3,450)
3‡	7.5	445	5		(0.1, 0.2, 706, 1192, >3,478)
Glass-backed wrapper	11.5	400	5	152	(95, 96.5, 153, 182, 234)
Silicone resins Treated glass cloth§					
Resin A	6.5	615	10	74	(Standard Derivation 46)
Resin B	6.5	615	10	168	(Standard Derivation 88)

‡ Experimental 3-sheet laminates vacuum impregnated with organic solventless thermosetting resin

§ 4-mil glass cloth treated by dipping

The mechanism of the corona attack is believed to be largely an electron bombardment of the material. Energetic electrons present in the corona streamers impinge on the surface, exciting the molecules sufficiently to produce rupture of chemical bonds and molecular fragments, which often recombine to low-molecular-weight volatile products.

The process can be considered in many respects analogous to the disruption of molecules by electrons in the ionization chamber of a mass spectrograph. Ozone attack also can occur, but is probably secondary, since tests on plastics in inert gases, argon and neon, by Brodhun and Perkins[8] produced failures in about the same time as in air.

Organic materials are susceptible to decomposition by energetic electrons to low-molecular-weight volatile products, but inorganic materials are less so. The structure of inorganic materials can be disrupted slowly by energetic electrons, resulting in the formation of new compounds or local recrystallization. Volatilization is less likely because of the low vapor pressure of inorganic decomposition products. Furthermore, with inorganic materials, because of their regular structure, there is greater chance for recombination of the original structure after atoms or ions are displaced. For these reasons mica has demonstrated a great superiority in corona resistance over all organic materials tested.

Mica also has weak points, as shown in Table I. At a gradient of 1,000 volts per mil, no failures occurred in greater than 1,500 hours, but at gradients over 2,000 volts per mil, the failure times ranged from less than an hour to greater than several thousand hours. The superiority of mica splittings over the best mica paper laminate has been demonstrated by tests.

The abnormally short failure times which already have been noted in Table I for the fluorinated polymers is understandable if it is pointed out that these fluorinated compounds are subject to decomposition by low-energy electrons of 1 to 2 electron volts by virtue of the large electron affinity of the fluorine. The release of a fluorine ion, which can initiate the decomposition, can be considered as the sum of two reactions for which the energy relations are known approximately:

$$\begin{array}{l} RF \rightarrow R\cdot + F\cdot - 4.54 \text{ electron volts} \\ e + F\cdot \rightarrow F^{-} + 3.58 \text{ electron volts} \\ \hline e + RF \rightarrow \mathrm{R}\cdot + \mathrm{F}^{-} - 0.96 \text{ electron volts} \end{array}$$

In the foregoing equations R represents the remainder of the carbon-fluorine molecule. The carbon-fluorine bond energy as given was that for a partially fluorinated compound. It may be somewhat higher for a completely fluorinated compound.

No reaction requiring such low electron energies can be postulated readily for other nonhalogenated organic polymers, but since a reaction is possible in the fluorine polymers, it can be understood why the decomposition of such polymers would proceed more rapidly in the presence of corona. At any given voltage gradient, corona streamers would contain more electrons of sufficient energy to decompose these fluorinated polymers.

SUMMARY

THE EFFECT of corona on the long-time dielectric strength of insulation is emphasized in this article, and various factors influencing the breakdown of insulation with corona are discussed. Data on the corona threshold voltages on dielectric surfaces at electrode edges show that the threshold voltage varies for a wide variety of dielectrics only as the ratio of dielectric thickness to dielectric constant.

The time to failure with corona varies inversely as the corona intensity, which is very low with direct current and increases with the frequency of applied voltage. It is shown that the dielectric strength in the presence of corona begins decreasing at the first cycle of alternating voltage and appears to level off only at the corona starting voltage.

The voltage endurance with corona does not vary much with dielectric thickness of unfilled resins for the same applied voltage gradient.

It has been noted that the time to failure with corona is strongly affected by weak points or defects in the insulation, which produce early failures. This is especially true with inorganic filled materials which derive their corona resistance from the filler, notably impregnated mica papers and silicone rubber. Fluorinated polymers have been shown to erode more rapidly with corona due to the low electron energy required to decompose them. Other organic resins tested all appear to have the same order of magnitude of resistance to corona.

REFERENCES

1. Dielectric Breakdown of Solids (book), **S. Whitehead.** Clarendon Press, Oxford England, 1951, chap. 4.

2. Dielectric Phenomena in High Voltage Engineering, **F. W. Peek, Jr.** McGraw-Hill Book Company, New York, N. Y., 1929, p. 245.

3. Dielectric Properties of Fibrous Insulation as Affected by Repeated Voltage Application, **F. M. Clark.** AIEE *Transactions*, vol. 44, 1925, pp. 193–210.

4. Breakdown Curve for Solid Insulation, **V. M. Montsinger.** AIEE *Transactions.* (*Electrical Engineering*), vol. 54, 1935, pp. 1300–01.

5. Dielectric Strength of Transformer Insulation, **P. L. Bellaschi, W. L. Teague** AIEE *Transactions*, vol. 56, 1937, pp. 164–71.

6. Impulse Dielectric Strength Characteristics of Liquid-Impregnated Pressboard **T. W. Dakin, C. N. Works.** AIEE *Transactions*, vol. 71, 1952, pp. 321–5.

7. Alternating and Direct Voltage Endurance Studies on Mica Insulation for Electric Machinery, **G. L. Moses.** AIEE *Transactions*, vol. 70, 1951, pp. 763–9.

8. Teflon, Polytetrafluoroethylene Resin as an Electrical Insulator, **J. R. Perkins, C. G. Brodhun.** Annual Report, 1949 Conference on Electrical Insulation, National Research Council, Washington, D. C., 1950.

9. Dielectric Breakdown of Polymers under Prolonged Stress, **Carl Brodhun.** *Physical Review*, New York, N. Y., vol. 86, 1952, p. 653A.

10. Dielectric Fatigue of Thermoset Laminates, **N. A. Skow, C. A. Belsterling.** *Modern Plastics*, New York, N. Y., vol. 27, July 1950, p. 93.

11. The Effect of Electric Stress on the Life of Cables Incorporating a Polythene Dielectric, **P. R. Howard.** *Journal*, Institution of Electrical Engineers, London, England, vol. 98, pt. II, 1951, pp. 365–70.

12. Internal Discharges in Dielectrics, Their Observation and Analysis, **A. E. W. Austen, W. Hackett.** *Ibid.*, vol. 91, pt. I, 1944, p. 298.

13. The Voltage Characteristics of Polyethylene Cables, **R. Davis, A. E. W. Austen, Willis Jackson.** *Ibid.*, vol. 94, pt. III, 1947, p. 154.

Electronic Cage Heater

Cage-by-cage heating controlled by a Minneapolis-Honeywell electronic indicator has been installed in the rebuilt reptile house at the New York Zoological Park, better known as the Bronx Zoo.

A feature of the system, worked out by the Zoo's consulting engineer, Henry Bond, and Minneapolis-Honeywell engineers, is a controlled "grading up" of temperatures toward the front of each cage, to the exact temperature preferred by the occupant. Thus the unsuspecting but comfort-loving creatures are lured into the positions in each cage where they can be seen to best advantage by the visiting public.

The electronic indicator permits engineers to obtain immediate temperature readings in any of 12 cages simply by depressing a push button for the specific cage for which such information is desired. The indicator is centrally located, thus eliminating treks to each cage location.

X-Ray Absorption Analysis of Treated Carbon

A. C. TITUS

CHEMICAL TREATMENTS in porous carbon blocks from which brushes are to be fashioned often are distributed unevenly so that the final brushes do not contain the calculated percentage of treatment obtained from weight relations. In order to analyze the treatment quantitatively under small individual areas, a practically instantaneous, nondestructive method of treatment has been applied which makes use of an X-ray absorption photometer.

This application to treated carbon first was made by the General Electric Research Laboratory and shortly afterwards the author began working on joint and separate projects with them. Various standards graphs or tables have been worked out for analyzing such treatments as lead chloride, cadmium, copper, and barium salts, as well as for spot densities of untreated carbon. Other groups now are using somewhat similar methods originally suggested by the work just mentioned.

The beam from a conventional (*CA 5*) X-ray tube goes through a beryllium window and then through a small orifice into the sample, emerging to strike a silver-activated zinc sulphide phosphor to produce a light in the blue-violet spectrum region. The phosphor is painted on the outside of the glass bulb of the type *931-A* multiplier phototube which changes the light into an electric current that is amplified and read on a milliammeter. Samples reduce the current read by the milliammeter, which is called the "output reading."

In order to apply the method, it is necessary to know the log output readings in terms of percentages of a treatment in carbon. The influence of the carbon is included in the standards curves for different thicknesses which do this, and in some cases corrections are necessary to counteract the effect of changes in density of the basic carbon in new samples. Since these standards curves, or tables made from them, vary with the instrument and with its settings they must be determined for each particular application and instrument. Thus, a purpose of this article is to illustrate the procedures in typical applications and thus to serve as a useful guide to those interested in setting up similar standards.

Setting of the photometer under any convenient intensity and other conditions is defined by measuring a set of aluminum pieces of different thicknesses and plotting against the log output readings. For future use it then can be reset in essentially this same way and minor adjustments can be made until the curve, or a desired segment of it, is duplicated.

In setting up the standards curves, it may be necessary to make basic curves by preparing carbon with zero per cent and other percentages of homogeneously distributed treatments. For each percentage several pieces of a definite thickness are selected which give essentially equal output readings. They then are piled up in multiples to give readings for increasing thicknesses. Upon plotting the log output readings against these thicknesses, a basic curve is made for each percentage of treatment. The percentage of treatment is determined by chemical analysis of some units of each set. A modification of this is to work with very thin sheets of a metal placed on the carbon pieces. By the use of densities the percentage of "treatment" is evaluated as if the metal were chemically analyzed within the carbon pores, giving the usual "weight per cent" values which are based on 100 per cent for combined carbon and treatment.

From the basic curves it is possible to construct the final standards curves. This can be done directly if enough basic curves were constructed but otherwise an equation can be set up which represents, for each thickness curve to be drawn, a shape such that this standards curve therefore passes through the zero and one other known treatment point.

Barium fluoride standards curves were constructed, where the fluoride could be neglected because of its very small relative absorptive effect so that they could represent barium in other simple treatments. However, in the case of barium bromide where standards curves also were built, both the barium and the bromide were important absorbers of X-ray energy. If barium bromide was measured using barium fluoride standards, the factor 2.93 represented, in this particular work, the relationship between the apparent barium in the various percentages of pure barium bromide treatment and the actual barium.

When a mixture of barium bromide and barium fluoride is present, the standards curves built for barium fluoride again will give an erroneously high value. But this "apparent barium percentage" value no longer will be susceptible to correction simply by using only the factor 2.93 as a divisor. It is obvious that another known quantity will be needed to solve the problem in addition to the "apparent barium (weight) per cent" value since the relationship between the basic unknowns, barium and bromide, is no longer fixed. In this case the total "weight per cent" of treatment within the block of carbon, if evenly distributed, can serve as the other known value. A graph was constructed from known values and relationships by which the analysis, therefore, could be made from the data.

It was shown also that maldistribution of water introduced barium bromide treatment, from vacuum impregnation, occurs only at the drying step and that a certain pretreatment did much to make this barium salt stay in place.

Digest of paper **54-202**, "Quantitative Analysis of Carbon Brush Treatments Using X-Ray Photometer Absorption Method," recommended by the AIEE Committee on Rotating Machinery and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer and Pacific General Meeting, Los Angeles, Calif., June 21–25, 1954. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1954.

A. C. Titus is with the General Electric Company, Schenectady, N. Y.

INSTITUTE ACTIVITIES

Extensive Technical Program Planned for Middle Eastern District Meeting

The AIEE Middle Eastern District Meeting, to be held at the Abraham Lincoln Hotel in Reading, Pa., October 5–7, 1954, will have as its setting the picturesque Pennsylvania Dutch countryside. A full program of technical sessions, social events, and inspection trips has been arranged. An extensive program for the ladies has also been planned with an accent on Pennsylvania Dutch cooking and customs.

At 10 a.m. on Tuesday morning, October 5, R. E. Neidig, vice-chairman of the meeting, will open the general session. He will introduce W. B. Morton, District 2 Vice-President, who will present the cash awards of $75 and $50 and certificates to the two technical prize paper authors in District 2 for 1953–54. The luncheon following the general session will be in charge of G. M. Keenan, Pennsylvania Power and Light Company, who will introduce the luncheon speaker, F. H. Lichtenwalter, formerly managing director of the Pennsylvania Electric Association.

Preceding the opening of the Middle Eastern District Meeting, the District Executive Committee will meet on Monday, October 4.

The AIEE Textile Subcommittee with F. D. Snyder as chairman will cosponsor the two textile sessions on Wednesday, October 6. A luncheon with a guest speaker will be held at 12:30 p.m.

INSPECTION TRIPS

Metropolitan Edison Company—Titus Station. The most recent addition to the electrical generating facilities of the Metropolitan Edison Company is the Titus Station in South Reading. Consisting of three generating units rated at 80,000 kw, each unit is made up of one turbine generator. Steam is generated at 1,450 pounds pressure, at 1,000 F. The generating voltage is 13,800 volts and the transmission voltage is 66,000 and 144,000 volts. The station uses approximately 35 carloads of coal per day with storage provisions for approximately 200,000 tons of coal. Approximately 160,000,000 gallons of water will be used daily in condensing steam from the turbines.

This is the first power plant in the East with walls of aluminum "C" panels. They consist of two sheets of 16-gauge aluminum, 16 inches wide and 8 feet long, separated by 3 inches of glasswool insulation. Felt is folded between the two metal members to prevent metal contact.

This 12-ton electric arc furnace of the Carpenter Steel Company will be seen on an inspection trip during the Middle Eastern District Meeting. Critical temperatures require constant pyrometer readings as pictured above. The electrode furnace is one of four in the plant. A novel feature is the amplidyne control of the electrodes

Future AIEE Meetings

First International Instrument Congress and Exhibition (Joint)
Commercial Museum and Convention Hall, Philadelphih, Pa.
September 13–24, 1954

Joint Symposium on Information Theory
Massachusetts Institute of Technology, Cambridge, Mass.
September 15–17, 1954
(*Final date for submitting papers—closed*)

Petroleum Technical Conference
Mayo Hotel, Tulsa, Okla.
September 27–29, 1954
(*Final date for submitting papers—closed*)

AIEE - IRE - RETMA - SMPTE - National Electronics Conference
Hotel Sherman, Chicago, Ill.
October 4–6, 1954
(*Final date for submitting papers—closed*)

Middle Eastern District Meeting
Abraham Lincoln Hotel, Reading, Pa.
October 5–7, 1954
(*Final date for submitting papers—closed*)

Fall General Meeting
Morrison Hotel, Chicago, Ill.
October 11–15, 1954
(*Final date for submitting papers—closed*)

Machine Tool Conference
Hotel Statler, Detroit, Mich.
October 25–27, 1954
(*Final date for submitting papers—closed*)

Mid-Atlantic Textile Conference
North Carolina State College, Raleigh, N. C.
November 4–5, 1954
(*Final date for submitting papers—closed*)

AIEE-IRE Conference on Electrical Techniques in Medicine and Biology
Morrison Hotel, Chicago, Ill.
November 10–11, 1954
(*Final date for submitting papers—closed*)

AIEE-IRE-ACM Eastern Computer Conference
Bellevue-Stratford Hotel, Philadelphia, Pa.
December 8–10, 1954
(*Final date for submitting papers—September 1*)

AIEE-IRE-NBS High-Frequency Measurements Conference
Hotel Statler, Washington, D. C.
January 17–19, 1955
(*Final date for submitting papers—October 18*)

Winter General Meeting
Hotel Statler, New York, N. Y.
January 31–February 4, 1955
(*Final date for submitting papers—October 20*)

Southern District Meeting
St. Petersburg, Fla.
April 13–15, 1955
(*Final date for submitting papers—March 29*)

A new landmark in the Reading area is the slender 1,036-foot completed steel television tower of station WHUM atop Blue Mountain about 1,500 feet above sea level. An unusual base not over 10 feet in circumference supports the tower, which is guyed every 175 feet by $1^{3}/_{4}$-inch guy wires. There are three parabolic disks—for video, audio, and remote broadcasts. Structures over the disks protect them from ice on the upper tower. WHUM, channel 61, was the first commercial uhf station east of Oregon and has a power output of 12 kw

Metropolitan Edison Company, Office Building. The new operating headquarters of the Metropolitan Edison Company is one of the most modern office structures of its type. Among the interesting features are the use of aluminum-brick construction, interior lighting, departmental arrangements, and the electric heat pump which will heat and cool the building through the use of well water. It is one of the first heat pump installations of its kind in the United States.

Carpenter Steel Company. This mill, which restricts its manufacture of steel to specialized requirements, produces a great variety of alloy steels, generally difficult to process, and turned out in many different sizes, forms, and relatively small amounts. Carpenter's new research laboratory is a recent adjunct to the maintenance of precision requirements and control of quality.

Textile Machine Works and Beryllium Corporation. The largest textile machinery manufacturer in the world and the Beryllium Corporation, manufacturers of special steels and alloys, are both located in Reading and are included in the schedule of inspection trips.

Golf facilities are available and arrangements may be made by contacting the Inspection Trip Committee during registration.

STUDENTS' ACTIVITIES

Wednesday, October 6, will be students' day at the Middle Eastern District Meeting. In the morning the regular District paper presentation will be held. A session on electronics and communications is planned with papers on television and transistors.

At noon a student luncheon will be held, to be addressed by President A. C. Monteith. In the afternoon the students may take the inspection trip to the Titus Generating Station of the Metropolitan Edison Company.

SOCIAL PROGRAM

Early arrivals will be entertained at an informal tea on Sunday afternoon in the Abraham Lincoln Hotel.

In addition to the students' luncheon on Wednesday, the Executive Committee will lunch on Monday at $2.50 per person including gratuities. Tickets for the general meeting luncheon on Tuesday may be obtained at the registration desk at $2.20 per person including gratuities. The Textile Subcommittee will also hold a Wednesday luncheon at 12:30 p.m.

The Fersommling, a "Pennsylvania Dutch" style party, will be held on Tuesday evening. There will be entertainment followed by a buffet supper. Tickets, available at the registration desk, will be $5.00 per couple, $3.00 per person.

The banquet is scheduled for Wednesday evening. "Dutch treat" cocktails will be served at 6:30 p.m. and dinner at 7:15, followed by entertainment by a choral group and dancing. Open to all members, ladies, and guests, dress will be informal. Advance reservations for tables of six or eight at $4.40 per person should be made through H. D. Moore, care of General Electric Company, 1014 Hamilton Street, Allentown, Pa. Checks should be made out to H. D. Moore, Chairman.

LADIES' ENTERTAINMENT

A committee of 50 ladies, with Mrs. D. L. Greene as chairman and Mrs. J. B. Homsher as vice-chairman, has arranged an enjoyable program for the ladies.

A coffee hour will be held in ladies' headquarters each morning at 8:30 except Tuesday, and a tea has been planned for Monday at 3:00 p.m. at no charge.

On Tuesday, brunch will be served at 11:00 a.m. in the Abraham Lincoln Hotel. Pennsylvania Dutch cook books and hand-painted favors of Pennsylvania Dutch design will be given each guest. Brunch will be followed by a trip through the Berkshire Knitting Mills, the largest hosiery mills in the world. Busses will leave the hotel at 12:30 p.m. and return at 3:00 p.m. Tickets are $2.00 each.

On Wednesday, a trip to Hershey has

(*Continued on page 822*)

Technical Program

Middle Eastern District Meeting, Reading, Pa., October 5-7

Tuesday, October 5

10:00 a.m. General Session

2:00 p.m. Mining and Quarrying

C54-425. Development of the Friedensville, Pa., Property of the New Jersey Zinc Company. *Warren Hastings*, New Jersey Zinc Company

C54-426. Developing the Resources of Our Land—Stone and Lime Processing in the Lebanon Valley. *D. K. Shroyer*, H. E. Millard Lime and Stone Company

C54-427. Iron Ore Mining at Cornwall and the New Grace Mine at Morgantown. *S. J. Shale, W. C. Lenhardt*, Bethlehem Cornwall Corporation

C54-428. The Electrical Design at Grace Mine. *F. O. Blair*, Bethlehem Steel Company

2:00 p.m. Power—I

C54-429. Design Features of Cromby Steam-Electric Station. *W. S. Einwechter, G. E. Klapper*, Philadelphia Electric Company

C54-430. The Martins Creek Steam and Electric Station of the Pennsylvania Power and Light Company. *S. C. Townsend, M. D. Engle*, Pennsylvania Power and Light Company

C54-431. Power Plant Operational Intercommunication. *A. L. Royle*, Gai-Tronics

C54-432. Electrical Design Features—Shawville Station. *M. F. Rosol*, Gilbert Associates, Inc.

2:00 p.m. Transmission and Distribution—I

C54-433. Techniques and Economies in Reconductoring Transmission and Subtransmission Lines. *F. S. Brown*, Cleveland Electric Illuminating Company

C54-434. System Voltage Control. *R. M. Butler, D. R. Samson*, General Electric Company

C54-435. Distribution Transformer Protection Schemes. *W. H. Mutchler, Jr.*, Allis-Chalmers Manufacturing Company

C54-436. 138-Kv Line Crossing of the Maumee River (Toledo, Ohio). *H. H. Dugan*, Toledo Edison Company

Wednesday, October 6

9:30 a.m. Textiles—I

Cosponsored by the AIEE Textile Subcommittee

C54-437. The Reading Full-Fashioned Knitting Machine. *R. F. Hornberger*, Textile Machine Works

C54-438. Adjustable Speed Drives for Full-Fashioned Knitting Machines. *E. H. Sowers*, Reliable Electric and Engineering Company

C54-439. Amplistat-Regulated Full-Fashioned Hosiery Machine Drive. *R. E. Parker*, General Electric Company

9:30 a.m. Steel—I

C54-440. Modern High-Capacity Electric Furnaces—Design. *J. W. Moore, W. B. Wallis*, Pittsburgh Lectromelt Furnace Corporation

C54-441. Operation of Basic Electric Furnaces in Steel Plants. *H. E. Bigge*, Bethlehem Steel Corporation

54-481. System Capacity Required for 3-Phase Arc Furnaces. *O. Ramsaur, J. E. Treweek*, Pennsylvania Power and Light Company

C54-442. Extensions to the Electric Generating and Distribution Systems at Sparrows Point. *H. D. Ruger*, Bethlehem Steel Corporation

9:30 a.m. Power—II

C54-444. Economic Generation Control. *W. S. Burt*, General Electric Company

C54-445. Ignitron Rectifier Excitation System for Power Stations. *M. M. Morak, M. Temoshok*, General Electric Company

C54-446. Magamps in Excitation System for Turbine Generators. *J. E. Barkle, D. M. Sauter*, Westinghouse Electric Corporation.

54-447. Field Preheating for Large Turbine Generators. *W. J. Gilson, H. D. Taylor*, General Electric Company

C54-468. Field-Welded Generator Lead Housings. *W. B. Morton*, Pennsylvania Power and Light Company

9:30 a.m. Transmission and Distribution—II

54-448. Simultaneous Single-Line-to-Ground Faults on Opposite Sides of Delta-Y Transformer Banks. *J. C. Neupauer*, Westinghouse Electric Corporation

C54-449. A Distribution Transformer Fuse Link, to End Burnouts Due to Overloading and Secondary Faults—Matthews Slofast. *G. Appleman*, Pennsylvania Power and Light Company

C54-450. Distribution Aspects of Mercury Lamps. *J. R. Morin*, Sylvania Electric Products, Inc.

54-451. Chemical Brush Control of Rights of Way. *L. Z. Ludorf*, Pennsylvania Power and Light Company

9:30 a.m. Communications and Television

C54-452. Recent Developments in Semiconductor Devices. *W. J. Pietenpol*, Bell Telephone Laboratories, Inc.

C54-453. UHF Television Broadcasting. *L. W. Haeseler*, Radio Corporation of America

C54-454. Germanium Refining and Crystal Growing, Using R-F Heating. *F. H. Bower*, Western Electric Company

C54-455. Principles of Color Television. *C. N. Hoyler*, RCA Laboratories

2:00 p.m. Textiles—II

Cosponsored by the AIEE Textile Subcommittee

C54-456. Variable-Speed-Range Drives. *C. E. Robinson, R. J. Farrell*, Reliance Electric Company

C54-457. Designing to Reduce Maintenance Costs. *A. W. Frankenfield*, E. I. duPont de Nemours Company

C54-458. Induction Motor Characteristics and Capabilities to Meet Textile Machine Requirements. *F. D. Snyder*, Westinghouse Electric Corporation

2:00 p.m. Industrials—I

C54-459. Large Oil-Cooled D-C Magnets. *W. C. Sealey*, Allis-Chalmers Manufacturing Company

C54-460. Transverse Flux Induction Heating. *R. M. Baker*, Westinghouse Electric Corporation

C54-461. Heat Pump Design in a Modern Office Building. *P. A. Kinsey*, Metropolitan Edison Company

C54-462. Increased Load Due to Stream Pollution Abatement. *R. W. Simpson*, Gilbert Associates, Inc.

2:00 p.m. Steel—II

C54-463. Power Supply and Utilization—Hoffman Machinery Corporation. *H. Landsman*, Hoffman Machinery Corporation; *T. Graham, W. P. Koppenall*, General Electric Company

C54-464. High-Powered Induction Heating in Shell Forging. *H. Landsman*, Hoffman Machinery Corporation; *A. T. Lattauzeo*, Westinghouse Electric Corporation.

54-465. Induction Heating Steel With 60 Cycles. *C. D. Kramer*, West Penn Power Company

C54-466. Specialty Steels for the Electrical Industry. *C. B. Post*, Carpenter Steel Company

2:00 p.m. Power—III

54-467. Equations for Determining Current Distribution Among the Conductors of Busses Comprised of Double-Channel Conductors. *C. M. Siegel*, University of Virginia; *T. J. Higgins*, University of Wisconsin

C54-443. All-Steel Station Grounding Network. *S. J. Litrides*, Pennsylvania Power and Light Company

54-469. Impedance and Induced Voltage Measurements on Iron Conductors. *W. F. Mackenzie*, Pennsylvania Power and Light Company

C54-470. Demonstration of the Principles of the Ultrasonic Flow Meter. *R. C. Swengel*, Consultant, York, Pa.; *W. B. Hess*, Safe Harbor Water Power Corporation; *S. K. Waldorf*, Pennsylvania Water and Power Corporation

---

—PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in the program may be obtained from AIEE Order Department, 33 West 39th Street, New York 18, N. Y., as noted in the following paragraphs.

—Prices of papers, irrespective of length, are 30 cents to members (60 cents to nonmembers) whether ordered by mail or purchased at the meeting. Mail orders are advisable, particularly from out-of-town members, as an adequate supply of each paper at the meeting cannot be assured. However, no advance copies are available of those papers bearing numbers prefixed by "C"; copies of such papers may be purchased at, or following, the meeting.

—COUPON books in nine-dollar denominations are available for those who may wish this convenient form of remittance.

—THE PAPERS regularly approved by the Committee on Technical Operations ultimately will be published in the bimonthly publications and Transactions.

2:00 p.m. Microwave, Telemetering, and Supervisory Control

C54-471. Things New in Supervisory Control and Telemetering. *W. M. Larson*, Control Corporation

C54-472. A New High-Speed Telemeter for D-C Measurements. *R. M. Stuart*, General Electric Company

C54-473. Control Problems in Remotely Operated Electrical Utility Stations. *W. A. Derr, W. L. Metz*, Westinghouse Electric Corporation

C54-474. Application of Microwave on Power Systems. *J. G. McKinley*, West Penn Power Company; *E. J. Muller*, Westinghouse Electric Corporation

Thursday, October 7

9:30 a.m. Industrials—II

C54-475. The Fluorescent Lamp Today and Tomorrow. *E. F. Lowry*, Sylvania Electric Products, Inc.

C54-476. Wafer Coil Techniques for Small Power Transformers. *A. Zack, J. C. Heffernan*, Sylvania Electric Products, Inc.

C54-477. Electrical Problems in Pipe-Line Operation. *R. I. Cozzens*, Keystone Pipe Line Company

C54-478. Air World Education. *J. H. Furbay*, Trans World Airlines

Laying of the Mackinac Pipe Line. (Film—"The Deep Inch") *Merrit, Chapman, Scott*

9:30 a.m. Substations—I

C54-479. Economics of Power Transformer Application. *L. W. Schoenig*, Allis-Chalmers Manufacturing Company

C54-480. "On-the-Line" Circuit Breaker Testing. *J. F. Zboyovsky, W. A. Kohar*, Roller-Smith Corporation

C54-482. 30-Degree Phase Shift Angle Displacement Program—Metropolitan Edison Company and Pennsylvania Electric Company. *R. W. Werts, R. E. Fuhrman*, Metropolitan Edison Company

54-491. A 500,000-Kva Power Fuse to Fulfill Requirements of Power Distribution at 34.5 to 69 Kv. *C. H. Baker, R. H. Harner*, S. & C. Electric Company

9:30 a.m. Management and General Interest

C54-483. Financial and Economic Aspects of Utility Systems. *M. G. Davis*, Gilbert Associates, Inc.

C54-484. How Our Business System Operates. *H. W. Bennett*, General Electric Company

C54-485. The Engineering Development of the Voice of America. *E. T. Martin, J. Ross, G. Jacobs*, International Broadcasting Services

C54-486. Effect of Radioactivity on Power Plant and Industrial Operation. *R. Gerstell*, Director of State Council of Civil Defense for Pennsylvania

9:30 a.m. Power Plant Safety and Fire Protection

C54-487. Protection Against Fires—Large Steam Turbine-Generator Units. *L. P. Grobel, J. J. Gibney, Jr.*, General Electric Company

C54-488. Safety and Fire Protection in Generating Stations. *G. F. Briner*, Gilbert Associates, Inc.

C54-489. Turbine Oil Fire Protection. *W. H. Lawton, C. F. Averill*, Grinnell Company, Inc.

C54-490. Fire Protection From an Operating Viewpoint. *E. F. Weaver*, Pennsylvania Power and Light Company

2:00 p.m. Substations—II

C54-492. Modern Trends in 220/66-Kv Substation Design. *W. J. Bartholomew*, Pennsylvania Power and Light Company

C54-493. Erection Steel for Standardizing Substations. *G. W. Swanson*, Consumers Power Company

C54-494. Models Help Utility Designers. *M. C Galiyano*, Pennsylvania Power and Light Company

2:00 p.m. Relays and Carrier Current

C54-495. Operating Difficulties With Carrier-Current Relaying. *S. S. Leach*, Pennsylvania Power and Light Company

54-496. Relaying the Metropolitan Edison Company's 230-Kv System. *G. E. May*, Metropolitan Edison Company; *W. C. New*, General Electric Company

C54-497. A Backup Ground Fault Relay Arrangement. *G. Appleman*, Pennsylvania Power and Light Company

2:00 p.m. Atomic Energy

C54-498. The Potential Prospects for Economic Atomic Power. *B. R. Prentice*, General Electric Company

C54-499. Operation of a Nuclear Power Plant in an Integrated Power System. *N. E. Wilson*, Westinghouse Electric Corporation

C54-500. Problems Confronting Development of Commercial Nuclear Power. *D. R. Rees*, Metropolitan Edison Company

(*Continued from page 820*)

been planned, with a visit to the museum, luncheon at the Hershey Hotel, and a visit to the Hershey Chocolate Plant. Tickets are $5.00 and busses leave the Abraham Lincoln at 9:15 a.m.

Thursday following the coffee hour private automobiles will be available to take visitors to points of interest in and about Reading.

It is of utmost importance that reservations be made for both the Tuesday and Wednesday trips as early as possible. Committee members will be in the English Lounge to accept reservations.

REGISTRATION

The registration facilities will be located on the lobby balcony of the Abraham Lincoln Hotel. They will be in operation Sunday, October 3, from 3:00 to 5:00 p.m., and from 8:30 a.m. on Monday through Thursday noon.

Advance registration is requested, by use of the advance registration card properly filled in. Registration fees are $3.00 for members and $5.00 for nonmembers; no fees will be charged to students or families of members. No remittance should be enclosed, but fees will be collected at the registration desk. By indicating on the advance registration card the number of persons and trips and activities that are of interest, the committee will be able to make the necessary arrangements in advance.

HOTEL RESERVATIONS

Rooms have been set aside at the following hotels for the members' use:

Abraham Lincoln Hotel

Double	$7.00–$9.00
Twin bed	8.00– 10.00
Single	5.00– 6.50

Berkshire Hotel

Double	6.50– 7.50
Twin bed	7.00– 8.50
Single	4.50– 5.50

Hotel reservations should be made as early as possible directly with the hotel chosen. No money or reservation requests should be sent to the committee.

TRANSPORTATION

Metropolitan Reading can be reached by rail, air, or highway. The Reading Railroad Company has regularly scheduled connections between Philadelphia and Harrisburg. Air service is available at the Reading Municipal Airport through the Colonial Air Lines, Capital Airlines, and Trans World Airlines.

Highway connections are many, including U.S. Routes 122, 222, 422, and state routes. It is only 15 miles from the Morgantown Interchange of the Pennsylvania Turnpike to the Abraham Lincoln Hotel. Bus lines enter Reading from all the major Eastern cities.

COMMITTEE

Members of the 1954 Middle Eastern District Meeting Committee include: W. B. Morton, general chairman; R. E. Neidig, vice-chairman; L. L. Nonemaker, Executive Committee secretary; Mrs. D. L. Greene, ladies' entertainment; J. O. Leslie, finance; D. L. Greene, hotels; F. S. Fehr, registration; E. F. Weaver, meetings; R. M. Wyatt, transportation; H. D. Moore, dinner-dance; J. E. Treweek, Fersommling; D. O. Eschbach, inspection trips; S. J. Litrides, publicity; F. W. Smith, students.

AIEE Board of Directors Holds June Meeting in Los Angeles

A regular meeting of the AIEE Board of Directors was held in the Biltmore Hotel, Los Angeles, Calif., on June 24, 1954.

EXECUTIVE COMMITTEE

Executive Committee actions on membership applications were reported and confirmed, as follows: May 26, 1954—96 applicants transferred and 14 elected to grade of Member; 2 Members re-elected; 2 applicants transferred and 535 elected to grade of Associate Member; 1 Associate Member reinstated; 35 Associate Members re-elected; 66 applicants elected to grade of Affiliate; 446 Student members enrolled.

Recommendations adopted by the Board of Examiners at meetings held on April 15, May 20, and June 9, 1954, were reported and approved as follows: 70 applicants transferred and 3 elected to grade of Member; 1 Member re-elected; 105 applicants elected to grade of Associate Member; 1 Associate member reinstated; 7 Associate Members re-elected; 13 applicants elected to grade of Affiliate; 118 Student members enrolled.

The Board of Examiners submitted 16 proposals for transfer to the grade of Fellow with a favorable recommendation and a recommended citation in each case. The Board of Directors voted to invite the 16 Members to be transferred to the grade of Fellow, as follows:

William D. Cannon, Assistant to Transmission Research Engineer, Western Union Telegraph Company, New York, N. Y.

Howard Austin Enos, Distribution Engineer, American Gas and Electric Service Corporation, 30 Church Street, New York 8, N. Y.

Carl R. Freehafer, Chief Executive Officer, Brazilian Telephone Company, Caica Postale 450, Rio de Janeiro, Brazil

Arthur Randolph Gatewood, Chief Engineer Surveyor, American Bureau of Shipping, 45 Broad Street, New York 4, N. Y.

Gordon William Gerell, System Superintendent of Meters and Relays, Union Electric Company of Missouri, 315 North 12th Boulevard, St. Louis 1, Mo.

Walter S. Gordon, Consulting Electrical Engineer, Tacoma, Wash.

Hakon H. Haglund, Assistant Director of Applied Engineering, Western Union Telegraph Company, New York, N. Y.

Emerson Edward Kimberly, Professor of Electrical Engineering, The Ohio State University, Columbus 10, Ohio

George Frederick Lincks, Supervisor—Lightning Arrester and Cutout System Engineering, General Electric Company, 100 Woodlawn Avenue, Pittsfield, Mass.

Vernon M. Marquis, Vice-President, American Gas and Electric Service Corporation, New York, N. Y.

Herbert Joseph Reich, Professor of Electrical Engineering, Yale University, Yale Station, D.L.E., New Haven, Conn.

Carl Martin Skooglund, Chief Electrical Engineer, West Penn Power Company, 14 Wood Street, Pittsburgh 22, Pa.

Joseph Sticher, Assistant Head of Electrical Division, The Detroit Edison Company, Detroit, Mich.

Gregory S. Timoshenko, Head of Electrical Engineering Department, University of Connecticut, Storrs, Conn.

Harold R. Vaughan, District Manager, Engineering and Service, Westinghouse Electric Corporation, Kansas City, Mo.

George Samuel Whitlow, Electrical Engineer, Union Electric Company of Missouri, 315 North 12th Boulevard, St. Louis 1, Mo.

See also: "AIEE Fellows Elected" in a future issue.

FINANCES

Treasurer Walter J. Barrett, unable to attend the meeting, submitted a written report for the fiscal year ending April 30, 1954. The Board voted to accept this report.

Chairman C. S. Purnell of the Finance Committee reported disbursements from the general funds as follows: April—$105,210.42; May—$121,112.00; June—$97,491.51. The report was approved.

A comparative statement of income and expenses for the first 9 months of the budget year was presented. It showed that the income to June 16, 1954, was $883,516, or 74.8 per cent of the estimated income for the appropriation year, ending September 30, compared with 74.3 per cent last year. Expenses for the 9 months ended June 30 were $936,045, or 74.3 per cent of the estimated expenses for the appropriation year, compared with 77 per cent last year.

ACTIONS AND APPOINTMENTS

Copies of the Annual Report of the Board of Directors were distributed, and approved.

N. S. Hibshman was reappointed Secretary of the Institute for the administrative year beginning August 1, 1954.

It was voted by the Board that travel expenses be authorized for the holding of two District Executive Committee meetings each year in those Districts where it is considered desirable by the Vice-President and the District Executive Committee and that the 1955 Conference of Vice-Presidents and District Secretaries be requested to review the experience of the year and report to the Board of Directors on the desirability of its continuation at that time.

The Board also voted to authorize travel expenses for one officer of each Subsection to attend the District Executive Committee meeting upon invitation of the Vice-President of the District, but without voting privileges in the deliberations of the District Executive Committee. Nothing in this authorization is to be understood to change the membership of the District Executive Committee as set forth in the Bylaws.

Upon recommendation of the Committee on Planning and Co-ordination, the Board authorized the holding of the 1955 Pacific General Meeting in Butte, Mont., August 15–19, and the 1957 Fall General Meeting in Pittsburgh, Pa., on a date to be selected later.

The Committee on Planning and Co-ordination recommended the adoption of revised prize rules for AIEE papers as proposed by the Committee on Award of Institute Prizes and endorsed by the Committee on Technical Operations (*see p. 825*). The Board voted to approve the recommendation.

The Board approved the recommendation that the name of the Committee on Award of Institute Prizes be changed to the "Committee on Prize Awards."

The Sections Committee recommended and the Board approved the establishment of the Hawaiian Section, from the Honolulu Subsection of the San Francisco Section; Iowa-Illinois Section, from the Quad-Cities Subsection of the Iowa Section; Lima Section, from the Lima Subsection of the Dayton Section; St. Maurice Valley Section, from the St. Maurice Valley Subsection of the Montreal Section; West Michigan Section, from the West Michigan Subsection of the Michigan Section. The formation of the following Subsections were reported: Western North Carolina Subsection (North Carolina Section), Maine Subsection (Lynn Section), Southern Colorado Subsection (Denver Section), Chillicothe Subsection (Columbus Section), Vermont Subsection (Pittsfield Section), Idaho Falls Subsection (Utah Section), Marion Subsection (Fort Wayne Section), Scioto Valley Subsection (Ohio Valley Section).

Upon recommendation of the Committee on Student Branches, the Board voted to approve the travel allowance for each counselor to attend such District Prize Paper Contests as may include an entry rom his Branch.

The Board approved the recommendation of the Committee on Student Branches that one complimentary copy of each of the three bimonthly *Transactions* publications, and one complimentary copy of *Electrical Engineering* be provided to the Counselor of each Student Branch to be made available for students of electrical engineering in his department as he may arrange. It was also recommended and approved by the Board that Student member subscriptions to the bimonthly publications to the extent of one such publication to each Student be $1.00 per year.

A letter from N. C. Pearcy was read to the Board announcing his resignation as a Director of the Institute, due to his acceptance of a position in Brazil. J. H. Foote was elected to succeed Mr. Pearcy.

As required by the bylaws of the committees, the Board confirmed appointments by President-elect Monteith of N. B. Ames and J. H. Lampe as members of the Charles LeGeyt Fortescue Fellowship Committee, and Carl Volz to be secretary at the pleasure of the committee; R. Cutts, Jr., J. D. Harper, and Elgin B. Robertson as members of the Edison Medal Committee for the term of 5 years beginning August 1, 1954; and the reappointment of James F. Fairman as chairman of the Edison Medal Committee for the year 1954–55. E. P. Yerkes was appointed to fill the unexpired term of Dr. K. B. McEachron, deceased. From its own membership, the Board elected L. F. Hickernell, A. C. Muir, and E. W. Seeger as members of the Edison Medal Committee for the term of 2 years beginning August 1, 1954. The Board confirmed the appointment of E. W. Engstrom, M. H. Hobbs, and C. T. Sinclair as members of the Lamme Medal Committee—each for the 3-year term beginning August 1, 1954. C. W. Franklin was appointed to succeed President-elect Monteith, who resigned from the Lamme Medal Committee.

Representatives of the Institute on various organizations were appointed (*see p. 857*).

The following Local Honorary Secretaries, whose terms expired July 31, 1954, were reappointed by the Board: V. J. F. Brain, for Australia; S. S. Kumar, for Northern India; M. S. Thacker, for Southern India; F. E. Ingham, for Transvaal.

President Robertson outlined briefly the progress being made toward the finding of a site for a new engineering headquarters building.

The Board voted to hold its next meeting in Pittsburgh, Pa., on August 12, 1954.

ATTENDANCE

Present at the meeting were: *President* Elgin B. Robertson; *Past Presidents* F. O. McMillan, D. A. Quarles; *Vice-Presidents* C. P. Almon, Jr., A. S. Anderson, W. L. Cassell, G. D. Floyd, W. Scott Hill, M. D. Hooven, C. M. Lytle, W. B. Morton, G. C. Tenney; *Directors* D. I. Cone, R. F. Danner, D. D. Ewing, J. H. Foote, L. F. Hickernell, T. M. Linville, A. C. Muir, C. S. Purnell, E. W. Seeger, Victor Siegfried, J. C. Strasbourger; *Secretary* N. S. Hibshman. By invitation: *President-elect* A. C. Monteith; *Vice-Presidents-elect* G. J. Crowdes, J. P. Neubauer, C. M. Summers, S. M. Sharp, J. R. Walker; and *Directors-elect* R. E. Kistler, E. S. Lammers.

Tenth National Electronics Conference to Meet in Chicago, Ill., October 4–6

The tenth annual National Electronics Conference will convene October 4–6, 1954, at the Hotel Sherman, Chicago, Ill. The technical program offers 88 papers covering a broad field of electronic research, development, and industrial application and is supplemented by over 160 booth exhibits by manufacturers foremost in the electronics field.

On the social side, the conference sponsors three luncheons featuring prominent speakers, an informal evening banquet on Tuesday, October 5, and a full 3-day social program for the ladies. The 10th anniversary of the conference will be celebrated at the Monday luncheon and the Tuesday evening banquet. Two evenings are available for viewing the exhibits or visiting any of the famous entertainment spots only a few steps from the Hotel Sherman.

The conference is sponsored by the AIEE, Illinois Institute of Technology, Institute of Radio Engineers, Northwestern University, and the University of Illinois, with Michigan State College, Purdue University, University of Michigan, University of Wisconsin, the Radio-Electronics-Television Manufacturers Association, and the Society of Motion Picture and Television Engineers participating. The president of this year's conference is Dr. R. M. Soria of the American Phenolic Corporation.

Advance registration may be made by writing to the National Electronics Conference, Inc., John S. Powers, Executive Secretary, 84 East Randolph Street, Chicago 1, Ill.

Tentative Program

National Electronics Conference

Monday, October 4

9:45 a.m. Magnetic Amplifiers I

Program prepared in co-operation with the AIEE Magnetic Amplifier Committee

Application of Magnetic Demodulator to Magnetic Amplifier Circuits. *J. L. Behr*, Vickers Electric Division

A 400-Cps Magnetic Amplifier for A-C Servo Application. *R. O. Decker, W. F. Horton*, Westinghouse Electric Corporation

A Miniature Amplistat for Aircraft Applications at 400 F Ambient Temperature. *R. H. Ball*, General Electric Company

Magnetic Amplifier Provides Automatic Gauge Control on Sendzimir Cold Rolling Mill. *E. V. Weir*, Magnetics, Inc.

9:45 a.m. Microwaves

Stripline. *E. G. Fubini*, Airborne Instruments Laboratory, Inc.

Stripline Excitation Methods. *F. S. Coale*, Sperry Gyroscope Co.

Microwave Components for Double-Ridge Waveguide. *L. Swern, K. Tomiyasu*, Sperry Gyroscope Co.

Determination of the Operating Performance of Waveguides of Arbitrary Cross Section by Hyper-Circle Analysis. *W. B. Swift, T. J. Higgins*, University of Wisconsin

Determination of the Characteristic Impedance of UHF Coaxial Rectangular Transmission Lines. *J. J. Skiles, T. J. Higgins*, University of Wisconsin

9:45 a.m. Information and Statistical Theory

Effectiveness of Crosscorrelation Detectors. *S. F. George*, Naval Research Laboratory

Optimum Linear Filtering of Nonstationary Time Series. *A. H. Koschmann*, University of Minnesota; *J. G. Truxal*, Polytechnic Institute of Brooklyn

On the Reliability of Networks. *G. H. Weiss, M. M. Kleinerman*, U.S. Naval Ordnance Laboratory

Designing Reliability Into Electronic Circuits. *A. H. Benner, B. Meredith*, Radio Corporation of America

12:30 p.m. 10th Anniversary Luncheon

Address: "The Day and the Men of Creation," by Dr. J. E. Hobson, director, Stanford Research Institute and first president of the National Electronics Conference

2:30 p.m. Magnetic Amplifiers II

Program prepared in co-operation with the AIEE Magnetic Amplifier Committee

A 2-Stage Low-Level Magnetic Amplifier With Negative Voltage Feedback. *F. Gourash*, Westinghouse Electric Corporation

Magnetic Switching Network for Data-Handling Systems. *L. P. Gieseler*, U.S. Naval Ordnance Laboratory

Single-Phase Magnetic Amplifiers With Decicycle Response. *L. J. Johnson*, Hufford Machine Works; *S. E. Rauch*, Santa Barbara College

Rectifiers in Magnetic Amplifier Circuits. *Bruce Seddon, Jr.*, General Electric Company

2:30 p.m. Circuit Theory I

Program prepared in co-operation with the Institute of Radio Engineers (IRE) Professional Group on Circuit Theory

A New Approach to the Potential Analogue Method of Network Synthesis. *E. W. Schwarz*, University of Illinois

An Introduction to a Qualitative Synthesis of Linear Passive Networks in the Time Domain. *F. Reza*, Massachusetts Institute of Technology

Parallel Ladder Realization of Transfer Admittance Functions. *E. S. Kuh*, Bell Telephone Laboratories, Inc.

Traps for Removing Transient Overshoot in Filters. *M. S. Corrington*, Radio Corporation of America

2:30 p.m. Microwave Instrumentation

Measurement of Very High Dielectric Constant Materials at Microwave Frequencies. *Isidore Bady*, Signal Corps Engineering Laboratory

A Cavity Perturbation Technique for Studying the Permeability Components of the Ferrites. *R. W. Brown*, U.S. Naval Ordnance Laboratory

A Method for Measuring the Loss of Waveguide Components Having Small Losses. *I. Tatsuguchi, L. H. Scheibe*, University of Wisconsin

Wide-Range SWR Indicator. *G. O. Thogersen*, Airborne Instruments Laboratory, Inc.

An X Band Phase Plotter. *Jack Bacon*, Ohio State University

2:30 p.m. Communications

Modulation Sideband Splatter of VHF and UHF Transmitters. *W. Firestone, Angus Macdonald, Henry Magnuski*, Motorola, Inc.

Transmission of Quaternary Pulses Over Band-Limited Wire-Line Facilities. *S. D. Bedrosian, Alfred Mack*, Signal Corps Engineering Laboratory

Detection of PCM Signals by the Integration Method. *H. F. Harmuth*, Signal Corps Engineering Laboratory

The Application of a Positive Grid Bias Multivibrator to F-M Broadcasting. *J. J. Metzner*, New York University

Tuesday, October 5

9:30 a.m. Circuit Theory II

Program prepared in co-operation with the IRE Professional Group on Circuit Theory

Application of the Ohio State University Filter Analysis Chart. *H. N. Dawirs, E. K. Damon*, Ohio State University

The Impulse Function in Electric Network Theory. *M. B. Reed, Sundaram Seshu*, University of Illinois

Pulse Response of Nonlinear Circuits. *G. I. Cohn*, Illinois Institute of Technology; *Bernard Saltzberg*, American Machine and Foundry Company

All-Pass Amplifier. *H. J. Woll*, Radio Corporation of America

A Technique for Solving Certain Networks Containing a Nonlinear Element. *W. L. Hughes*, Iowa State College

9:30 a.m. Instrumentation I

An Ocean-Wave Power Spectrum Analyzer. *S. S. L. Chang*, New York University

Direct Reading Probability Distribution Meter. *H. L. Davis*, Captain, United States Air Force; *G. R. Cooper*, Purdue University

An Instrument for the Precise Comparison of Impedance and Dissipation Factor. *M. C. Holtje, H. P. Hall, I. G. Easton*, General Radio Company

A New Sweep for Displaying the True Parameters of a Network. *R. W. Sonnenfeldt*, Radio Corporation of America

9:30 a.m. Management of Small Research and Development Organizations

Program prepared in co-operation with the IRE Professional Group on Engineering Management

Engineering Management in Electronics. *J. G. Reid, Jr.*, ACF Electronics

Engineering Management in a Growing Laboratory. *R. E. Samuelson*, Motorola, Inc.

Management of a Small Research and Development Organization. *G. L. Davies*, The Davies Laboratories, Inc.

Opportunities Presented to an Engineer by a Small Research and Development Organization With Good Management. *Arthur Maciszewski*, ARF Products, Inc.

9:30 a.m. Radar and Navigation

Oceanography and Electronics Meet at the Surface of the Sea. *A. H. Schooley*, Naval Research Laboratory

Radar Interference Caused by Atmospheric Reflections. *George Opdycke, Peter Kennedy*, Westinghouse Electric Corporation

An MTI Evaluator. *J. R. Wilkerson*, Airborne Instruments Laboratory, Inc.

Subminiature Air-borne Communications and Navigation Equipment. *P. D. Rockwell*, Bendix Radio Division

12:30 p.m. Luncheon

Address: "The Importance of Technical Symposia," by Dr. A. N. Goldsmith

2:30 p.m. Television

A New Method of Eliminating the Transient Distortion Associated With Vestigial Sideband Systems of Transmission. *T. Murakami, R. W. Sonnenfeldt*, Radio Corporation of America

A Linear Color Television Receiver. *C. H. Jones*, Westinghouse Electric Corporation

Cathode-Ray-Tube Deflection System Using Transistors. *J. W. Taylor, Jr., T. M. Moore*, Westinghouse Electric Corporation

2:30 p.m. Electron Tubes

Characteristics and Structural Features of Developmental Low-Noise Traveling-Wave Tubes for S- and C-Band Operation. *P. R. Wakefield*, Radio Corporation of America

New Developments in the Raytheon Recording Storage Tube. *R. C. Hergenrother, A. Luftman, C. Sawyer*, Raytheon Manufacturing Company

A Closed Form for the Transit Time of Electrons With Initial Velocities Traveling Between Two Paralle Plane Electrodes. *M. Javid*, Illinois Institute of Technology

The Transient Conduction of Current in Very-Low-Pressure Xenon-Filled Hot-Cathode Diodes. *J. C. Schuder*, Purdue University

2:30 p.m. Instrumentation II

Measurement of Dielectric Absorption in Quality Capacitors Required for High-Accuracy RC Timing Circuits. *H. E. Ruehlemann*, U.S. Naval Ordnance Laboratory

Coating Thickness Measurements Using Pulsed Eddy Currents. *D. L. Waidelich*, Argonne National Laboratory

Improved Electronics Apparatus for Measuring Deception-Induced Physiological Changes. *H. J. Dana, C. C. Barnett, D. R. Denison*, State College of Washington

Broadband Automatic Attentuation Recorders for Microwave Frequencies. *R. E. Henning, H. W. Hunt*, Sperry Gyroscope Company

2:30 p.m. Computers

A Formal Procedure for the Logical Design of an Optimum Counter. *Bernard Cohen*, Raytheon Manufacturing Company

Accuracy and Speed in Analogue Computer Dividing Circuits. *C. D. Morrill*, Goodyear Aircraft Corporation

Electromechanical Analogue Simulates Transient Phenomena and Governor Action in 10-Kc Network Analyzer Generators. *C. M. Davis*, Iowa State College

The Electronic Aspects of the Canadian Sorting-of-Mail System. *M. Levy*, Post Office Department, Ottawa, Ont., Canada

Wednesday, October 6

9:30 a.m. Electronics Circuits

Electronic Filter for High-Voltage Power Supplies. *Victor Wouk*, Beta Electric Corporation

Integrating Amplifier. *R. N. Close*, Airborne Instruments Laboratory, Inc.

A New High-Quality Audio-Amplifier Output Circuit. *D. J. Tomcik, A. M. Wiggins*, Electro-Voice, Inc.

Universal Power Supplies for Vehicular Radio. *Ken Backman*, Motorola, Inc.

9:30 a.m. Solid-State Devices and Circuits

Power Gain of a Dielectric Amplifier. *Stanley Zisk*, U.S. Naval Ordnance Laboratory

A New Microwave Detector Using a Cadmium Sulfide Thin-Film. *Gene Strull*, Northwestern University

Voltage Punch-Through and Its Effect on the Maximum Operating Voltages for Junction Transistors. *H. Schenkel, H. Statz*, Raytheon Manufacturing Company

A Single-Junction Transistor Bistable Flip-Flop Circuit. *W. D. Rowe*, Westinghouse Electric Corporation

Design Considerations of Junction Transistors at Higher Frequencies, Based Upon an Accurate Equivalent Circuit. *Ernst Guillemin*, Massachusetts Institute of Technology; *Herman Statz, Robert Pucel*, Raytheon Manufacturing Company

9:30 a.m. Antennas

Coaxial Omnidirectional Slot Antenna Arrays. *S. I. Cohn, A. J. Hoehn*, Armour Research Foundation; *G. I. Cohn*, Illinois Institute of Technology

Excitation of Vehicles as Radiators in the Medium-Frequency Range. *I. J. Stampalia*, Stanford Research Institute

Microwave Images. *J. R. Patty, E. H. Hurlburt*, U.S. Naval Ordnance Laboratory

A Magnetic Radio Compass Antenna Having Zero Drag. *Alfred Hemphill*, Bendix Radio Division

12:30 p.m. Luncheon

Address: Dr. J. W. McRae, president, Sandia Corp.

2:30 p.m. Electron Tube Reliability

Program prepared in co-operation with the AIEE Subcommittee on Electron Tubes of the Committee on Electronics

Development of the Premium Triode RCA-6J4-WA. *G. W. Barclay*, Radio Corporation of America

Vacuum-Tube Reliability in the Univac. *L. D. Wilson*, Remington Rand, Inc.

Experience With Tube Reliability in the Industrial Control Field. *E. H. Dinger*, General Electric Company

Reliable Voltage Regulator Tube. *R. E. Lynch*, CBS-Hytron

Factors Affecting Tube Life in Present-Day Military Applications. *J. R. Garfola*, Aeronautical Radio, Inc.

2:30 p.m. Servomechanism and Control

An Appraisal of Nonlinearities in Servomechanisms. *D. C. McDonald*, Cook Research Laboratories.

A New Simple General Criterion for Determining the Stability of Servomechanisms. *T. J. Higgins, E. M. Michalak*, University of Wisconsin

Additions to Sampled-Data Theory. *G. V. Lago*, University of Missouri

A Simplification of Aircraft Automatic Antenna Tuning. *D. T. Geiser*, Sprague Electric Company

2:30 p.m. Materials and Components

Low-Power Pulse Transformers Utilizing Ferrites. *Michael Geroulo, Lawrence Hobson*, Sprague Electric Co.

A Wide-Band High-Frequency Transformer Using a Ferrite Core. *T. R. O'Meara*, University of Illinois

Noise in Composition Resistors. *G. T. Conrad, Jr.*, National Bureau of Standards

Automatic Production of Wafer Coil Inductive Components. *A. Zack, T. Wroblewski*, Sylvania Electric Products, Inc.

New Prize Rules for AIEE Papers Approved by Board of Directors

The following rules for the award of prizes for AIEE papers were approved by the Board of Directors on June 24, 1954, superseding those previously in effect.

INTRODUCTION

In order to recognize and promote the contribution of meritorious papers, the AIEE has established a series of prizes which are available for annual award to members for outstanding papers presented at its meetings. All awards are optional, not obligatory, and it is expected that discriminating judgment will be made by each responsible committee. Each prize consists of a sum of money and/or a Certificate of Award. Appropriate recognition will be given in *Electrical Engineering* and the AIEE "Year Book."

PRIZES

The following prizes are available each year:

1. *Institute*

Class	First Prize	Additional Prize
(*a*). Each Division Communication General Application Industry Power Science and Electronics	$100 and certificate	Certificate (In special cases additional certificates may be awarded at the discretion of the Committee on Prize Awards for Institute papers.)
(*b*). Paper outside Division jurisdiction	$100 and certificate	None
(*c*). Best Student paper	$100 and certificate	Certificate

2. *District*

Class	First Prize	Additional Prize
(*a*). Best paper, any class	$75 and certificate	$50 and certificate
(*b*). Best paper presented by undergraduate Student member in District competition	$25 and certificate	Certificate

3. *Section*

$100 to be divided at the discretion of the Section, with a maximum of $50 for any one prize, and certificate for each winner.

4. *Branch* (*Undergraduate*)

Class	First Prize	Additional Prize
(*a*). Best paper	$10 and certificate plus an allowance of 13 cents per mile one way for 800 miles or less and 10 cents per mile one way for remaining distance to the District Student prize paper competition	Certificate

Any monetary prize will be divided between coauthors and each will receive a certificate. Certificates and checks for awards are prepared at Headquarters under the cognizance of the Committee on Prize Awards. Equivalent gift may be substituted for the monetary prize.

ELIGIBILITY

To be eligible for an award a paper must have been presented at a qualified technical meeting of the AIEE (Winter, Summer, Fall, or Pacific General Meeting; District meeting; Special Technical Conference; Section, technical group, or Subsection meeting; or Branch meeting). Only *Transactions* papers shall be eligible for Division prize awards. AIEE committee and subcommittee reports are not eligible for prizes.

To be eligible for any award, the author, or at least one coauthor, of a paper must be a member (any grade) of the Institute and the other coauthors must be members of a professional society of comparable standing. District, Section, and Branch prizes will be limited to papers, one of whose authors is resident or employed within the respective territory.

All prizes will be awarded on the basis of papers presented during the administrative year, nominally August 1 to July 31.

ENTRANCE REQUIREMENTS

All *Transactions* papers will be considered for Division prizes without formal offering in competition.

All papers outside Division jurisdiction will be considered for Institute award if submitted in triplicate to the Institute Secretary before July 31 of the administrative year in which presented and accompanied by a written statement as to when and where presented.

All Student papers which have won a prize in Branch or District Student competition will be considered for Institute award if submitted in triplicate to the Institute Secretary before July 1 of the administrative year in which presented and accompanied by a written statement as to when and where presented.

All *Transactions* papers will be considered for District prizes without formal offering in competition. In addition, all papers presented at qualified meetings will be considered for District award if submitted in triplicate to the District Secretary before the end of the administrative year in which presented and accompanied by a written statement as to when and where presented. The District Student Prize Paper competition is limited to papers which have received first prize in a Branch competition.

When three or more papers are submitted to the respective secretaries for *Section* or *Branch* competition, arrangements shall be made for presentation before the Section or Branch at a meeting set aside for that purpose and committees selected to judge each such contest.

GENERAL INFORMATION

1. *Presentation of Awards*

Awards will be presented as follows: Institute prizes at the regular Winter General Meeting; District prizes at a meeting within the District or at some other meeting upon approval of the District Executive Committee; Section prizes at Section meetings; and Branch prizes at Branch meetings.

2. *Competitive Presentation*

Prizes based on competitive presentation may be withheld whenever in the opinion of the responsible committee the number of papers is not sufficient to constitute a real competition. Such papers may be included in competition with those presented in the following year.

BASIS OF GRADING

1. *Institute, District, and Section Papers*

The valuations which govern the grading of Institute, District, and Section papers for the purpose of awarding best paper prizes are

Analysis of subject—15 per cent
Logical presentation—15 per cent
Originality—15 per cent
Unit—15 per cent
Value in electrical engineering field—40 per cent
(Except in Section competition where value will be rated 20 per cent and oral presentation 20 per cent)

2. *Student Papers*

Since the objective of Student papers differs from that of other papers, a different basis of grading has been adopted. It is not the primary purpose of Student papers to contribute to the technical advancement of the profession; they should constitute a vehicle for the training and stimulation of future contributors to the profession. To this end greater emphasis has been placed on written presentation and the exercise of engineering thinking than on technical value.

A. *Written Presentation:*

Originality—13 per cent
Survey of subject (analytical procedure)—10 per cent
Importance—10 per cent
Appropriateness—6 per cent
Mode of Expression—

(*1*). Logical organization of material for clarity, forcefulness, and interest. Appropriate headings are essential. (7 per cent)

(*2*). Concise and coherent expression of thoughts in good English and with proper choice of words. (7 per cent)

(*3*). Effective and judicious use of pictorial and graphical presentation. (7 per cent)
Adequate introduction and closure—6 per cent

B. *Oral Presentation:*

Speaking technique—12 per cent
Style (organization of material)—12 per cent
Introduction and conclusion—5 per cent
Discussion—5 per cent

COMMITTEES ON PRIZE AWARDS

1. *Institute*

The Committee on Prize Awards is appointed annually by the Institute President in accordance with the Bylaws.

2. *District*

The Committee on Award of District Prizes shall be appointed annually by the District Vice-President and shall consist of not less than three Members or Fellows of the Institute. Judges of oral presentation of Student papers need not be the same as judges of written presentation and they may include Associate or non-Institute members when necessary.

3. *Section*

The Committee on Award of Section Prizes shall be appointed annually by the Section chairman and shall consist of not less than three Associate Members, Members, or Fellows of the Institute.

4. *Branch*

The Committee on Award of Branch Prizes shall be appointed annually by the Student Counselor and shall consist of not less than three Associate Members, Members, or Fellows. When necessary, a non-Institute member may be selected.

5. *Division*

A Subcommittee on Prize Awards shall be appointed by each Division chairman at the beginning of the administrative year and shall consist of not less than three members of the Division. Recommendations for Division prizes for papers presented during the administrative year shall be submitted by this subcommittee to the Committee on Prize Awards not later than September 1 of the following administrative year.

EFFECTIVE DATE OF RULES

These rules became effective with the administrative year beginning on August 1, 1954.

PROCEDURE FOR REVISION

These rules for prize awards are subject to revision by the Board of Directors of the Institute.

First Petroleum Industry Conference to Be Held at Tulsa, World Oil Capital

The first AIEE Electrical Conference of the Petroleum Industry will take place in Tulsa, Okla., at the Mayo Hotel, September 27–29, 1954. This 3-day technical conference is under the sponsorship of the newly formed AIEE Petroleum Industry Committee with the Tulsa Section of the Institute acting as host.

Latest developments in the use of electricity and electric equipment in the petroleum industry will be covered in 19 technical papers to be presented by outstanding engineers. The purpose of the conference is to advance the art of electrical engineering and provide an interchange of electrical technology through an industry-wide coverage of applications in oil and gas production, refining, transportation, and allied petro-chemical fields. The meeting will be open to all interested in the program, whether they be mechanical, petroleum, chemical, communication, or electrical engineers, or men who are interested in operation or maintenance.

The sessions on the first day will be devoted to refining subjects with two papers on general subjects being given that evening. Pipeline subjects will be covered in the next day's sessions and the production of gas and oil will be covered in the final sessions.

Mayor L. C. Clark of Tulsa will welcome the visitors at the opening general session at which the keynote address will be given by Major A. N. Horne of the Texas-Empire Pipe Line Company.

Governor Johnston Murray of Oklahoma, and honorary member of the Oklahoma Society of Professional Engineers, will be the guest speaker at a joint luncheon of the conference and the Tulsa Engineers Club on Monday.

On Tuesday evening a Stag Fellowship and Social Hour is scheduled before the Stag Buffet banquet at which the major address will be by AIEE President A. C. Monteith; this will then be followed by entertainment.

On Wednesday noon, a luncheon meeting of the officers and members of the AIEE Petroleum Industry Committee has been called by the chairman, J. Z. Linsenmeyer, for studying means to give more recognition to the needs of electrical engineers within the petroleum industry. Growing interest is expected to justify a continuing series of electrical conferences of petroleum-industry personnel annually rotating among AIEE Sections in the Southwest where there is the greatest interest in the subject.

On Wednesday afternoon, inspection trips are scheduled for those who signed up in advance. The recently completed multimillion-dollar Stanolind Research Laboratory in the Tulsa residential suburbs has offered guided tours to those interested. Bus transportation will be available at nominal rates. Here guests will see the latest scientific facilities and techniques employed in furthering exploration and production of oil and gas on land and sea.

The entire facilities of the air-conditioned Mayo Hotel will be available for the conference. Hotel reservations will be confirmed by the hotel after return of the pre-registration form. Rates: single rooms, $6.50–7.00 per day; room with twin beds, $9.00–12.00 per day; parlor and 1-bedroom suite, $25.00 per day; and parlor and 2-bedroom suite, $30–50 per day. The registration fee is $3.00, payable in advance or when registering. Make registration checks payable to Dale H. Watt, Treasurer, Electrical Conference of the Petroleum Industry. Tickets for the joint Conference–Engineers Club luncheon on Monday will be $1.35 and should be purchased in advance when registering.

Tulsa, "The Oil Capital of the World," offers many recreational facilities: among these are the Philbrook Art Center, Thomas Gilcrease Museum, Municipal Rose Garden, golfing and baseball, and a 25-minute drive takes you to the Will Rogers Memorial and Shrine at Claremore. Two large oil refineries are located at Tulsa with the latest in modern equipment including the first platinum catalytic reforming unit in commer-

Air view of Tulsa with refineries in foreground cial operation. Conducted tours will be arranged on a few hours' notice.

Policy-determining executives within the petroleum industry are being urged to send their key designing, operating, and maintenance personnel to this conference. Direct mailing of pre-registration forms, request for hotel accommodations, together with the complete program, has already been made. Anyone desiring to attend, who failed to receive these forms, should write promptly for them to M. C. Callahan, Registration Chairman, care of Gulf Refining Corporation, Post Office Box 661, Tulsa 2, Okla.

The chairman of the conference executive committee is W. H. Stueve and its vice-chairman is V. J. Sittel. Chairmen of the operating committee are as follows: M. C. Callahan, registration and hotel arrangements; V. J. Sittel, reception; W. H. Stueve, technical program; W. F. Hildebrand, finance; D. H. Watt, treasurer; J. H. Elsloo, entertainment; G. R. Van Burkleo, inspection trips and transportation; H. M. Furtney, publicity; R. D. Bennett, printing and program; D. L. Johnson, student participation.

Program

Petroleum Industry Conference

Monday, September 27

10:00 a. m. Opening Ceremony and General Session.

Introductions. Welcome by Mayor L. C. Clark.

Keynote Address. Major A. N. Horne, Texas-Empire Pipe Line Company

11:00 a. m.

Training of Maintenance Personnel at Socony-Vacuum Refinery, East St. Louis, Ill. *A. J. Claes*, Socony-Vacuum Oil Company

12:00 noon. Joint Luncheon with Tulsa Engineers Club

Address by Hon. Johnson Murray, Governor of Oklahoma

2:00 p.m.

Some Features of Power Systems for Oil Refineries. *H. M. Stewart*, Humble Oil and Refining Company

Problems of Power Suppliers in Relation to Sales to Oil Industry Applications, Competition, and Facility Agreements, Contracts. *T. E. Graham*, Oklahoma Gas and Electric Company

Lightning Protection in Petroleum Refineries and Chemical Plants. *J. V. Cundelan, E. C. Benjamin*, M. W. Kellogg Company

8:00 p.m.

The Background, Intent, and Application of the Rules Contained in Article 500 of the National Electrical Code. *C. M. Park*, Mill Mutual Fire Prevention Bureau

Illustrated Lecture on **Typical Explosion-Proof Installations.** *R. B. West*, Blaw-Knox Company, Chemical Plants Division

Tuesday, September 28

9:30 a.m.

Design of Automatic Pump Stations, Pressure Control, Single Motor. *Paul P. Plovanich*, Service Pipe Line Company

Application of Large A-C Motors and Control to Refineries and Pipe Lines. *G. L. Oscarson*, Electric Machinery Manufacturing Company

Discussion of above paper by *C. F. MacGinnis*, Elliott Manufacturing Company

Relation Between Speed Torque of Motors at Various Starting Inrush Currents and Speed Torque Relation for Closed and Open Head Gate Valves. *Benton Bejack*, General Electric Company

Uses of Radioactive Substances in the Petroleum Industry. *William Jarzembski*, Jarco Services Inc.

2:00 p.m.

The Use of Oil Circuit Breakers for Pipe-Line Pump Stations. *H. A. Norberg*, Nelson Electric Manufacturing Company

Terminal Circuitry for Remote and Automatic Control of Pipe-Line Pumping Stations. *M. A. Hyde, W. A. Derr*, Westinghouse Electric Corporation.

Maintenance Control and Procedure for Electrified Pipe-Line Pumping Stations. *R. M. Culver, Jr.*, Plantation Pipe Line Company

6:00 p.m. Stag Fellowship and Social Hour

Refreshments served

7:00 p.m. Stag Buffet Banquet

Crystal Ball Room, Mayo Hotel
Address by AIEE President A. C. Monteith
Entertainment

Wednesday, September 29

9:00 a.m.

Use of Electric Heating in Relation to Paraffin Problems. *G. A. Smith*, Shell Oil Company

Use of and Late Developments of Reda Submerged Pump Units. *Joe Carle*, Reda Pump Company

Use of Electrodrill for Oil Well Drilling and/or Core Taking. *T. Sutton*, Reda Pump Company

Economic Aspects of Using Electric Power for Flood ing in Secondary Recovery of Oil-Producing Fields. *J. R. Hatfield, Frank Beach*, Cities Service Oil Company

12:00 Noon. Luncheon for Members of Petroleum Industry Committee Only

Afternoon Inspection Trips

For those who signed up at time of registration

2:30 p.m.

Electric Equipment Maintenance Costs, Motor Control for Indoor and Outdoor Applications. *T. L. Scott*, Phillips Petroleum Company

Design of Distribution Systems for Lease Electrification. *B. L. Moore*, Humble Oil and Refining Company.

All the foregoing are Conference Papers. Some papers may appear in *Electrical Engineering* or some may be approved later for publication in the bimonthly publications and *Transactions*.

EJC Initiates Program to Meet Nuclear Problems

To meet "the pressing problems of nuclear engineering and the related sciences," with particular interest in "industrial usefulness," Engineers Joint Council (EJC) has announced initial steps toward an organized program of confronting these problems "authoritatively by a group of leading engineers."

In making the announcement, Thorndike Saville, president of the Council and dean of engineering at New York University, commented that "action by this powerful engineering group is further evidence that nuclear energy is well on the way to having important peacetime industrial usefulness."

An early invitation will be extended to the societies of physicists and chemists to join the engineers in planning a strong organization, it was reported by Warren L. McCabe, administrative dean at Brooklyn Polytechnic Institute, chairman of the EJC Committee on Recognition of Specialties in Engineering.

Although organization of the new group is in its initial stages, a national convocation in 1955 is contemplated for discussion of nuclear development for industrial use.

The announcement was as follows:

"The pressing problems of nuclear engineering and the related sciences are to be dealt with authoritatively by a group of leading engineers.

"In this announcement, Thorndike Saville, president of Engineers Joint Council, is joined by Daniel V. Terrell, president of the American Society of Civil Engineers; Leo F. Reinartz, president of the American Society of Mining and Metallurgical Engineers; Lewis K. Sillcox, president of The American Society of Mechanical Engineers; Alexander C. Monteith, president of the American Institute of Electrical Engineers; Chalmer G. Kirkbride, president of the American Institute of Chemical Engineers; Dale L. Maffitt, president of the American Water Works Association; William E. Blewett, Jr., president of the Society of Naval Architects and Marine Engineers, and Nathan W. Dougherty, president of the American Society for Engineering Education. Under the general policy of Engineers Joint Council to encourage the close co-operation of specialists in engineering, a strong joint agency will be set up to organize the co-operation of all engineering groups and related scientists to develop discussions of nuclear engineering subjects and to deal with the publication of worth-while papers and addresses.

"The total membership of the federated societies known as Engineers Joint Council is about 170,000. The membership includes several thousand skilled engineers who are working on the critical problems of mining, processing, and the use of all the materials involved in the production of energy by fission.

"Action by this powerful engineering group is further evidence that nuclear energy is well on the way to having important peacetime industrial usefulness."

As to the likelihood of an invitation to others to join the group, Dean McCabe said:

"We agree as to the desirability of bringing in the physicists, chemists, and perhaps other related groups, but at the moment our responsibility is largely in the engineering field."

Fall General Meeting in Chicago to Feature Wide Range of Subjects

The Morrison Hotel in Chicago, Ill., the center of one of the greatest diversified industrial areas in the world, will be the scene of the AIEE Fall General Meeting, October 11–15, at which a broad technical program covering the five divisions of the Institute will be assured.

TECHNICAL SUBJECTS

Special attention will be given to the air transportation industry with eight sessions being planned around that subject. Forty-five additional sessions are being organized in the five technical divisions of the Institute. The Power Division committees now engaged in this planning are those on Carrier Current, Insulated Conductors, Power Generation, Protective Devices, Relays, Rotating Machinery, Switchgear, System Engineering, Transforms, and Transmission and Distribution.

In the Science and Electronics Division, the Committees on Computing Devices, Instruments and Measurements, Electronics, Basic Sciences, Magnetic Amplifiers, and Nucleonics are represented. Six sessions are also scheduled by the Communications Division Committees on Communication Switching Systems, Radio and Wire Communication Systems, and Television and Aural Broadcasting.

In the Industry and General Applications Divisions the following committees will sponsor programs: Chemical, Electrochemical and Electrothermal Applications, Feedback Control Systems, Industrial Control, Mining and Metal Industry, Industrial Power Systems, Air Transportation, Land Transportation, and Metallic Rectifiers. Sessions are also being organized by three general committees of the Institute: Education, Safety, and Management.

Plans have been completed for inspection trips to utility plants, steel mills, manufacturing centers, and research institutes during the 5-day convention which begins Monday, October 11.

Members of the AIEE attending this meeting will also be interested in the Golden Jubilee Celebration of Eta Kappa Nu. This year is the 50th anniversary of the founding of Eta Kappa Nu Association, the electrical engineering honor society. To commemorate it a Golden Jubilee Celebration will be held on the University of Illinois campus at Urbana, the weekend of October 15 and 16, with most of the activity on Saturday. Since Urbana is only a few hours from Chicago, this will give members an opportunity to attend the many scheduled events that will be of interest not only to them but also to their families. Additional information on this program can be obtained by writing to Professor D. S. Babb, 155 Electrical Engineering Building, University of Illinois, Urbana, Ill.

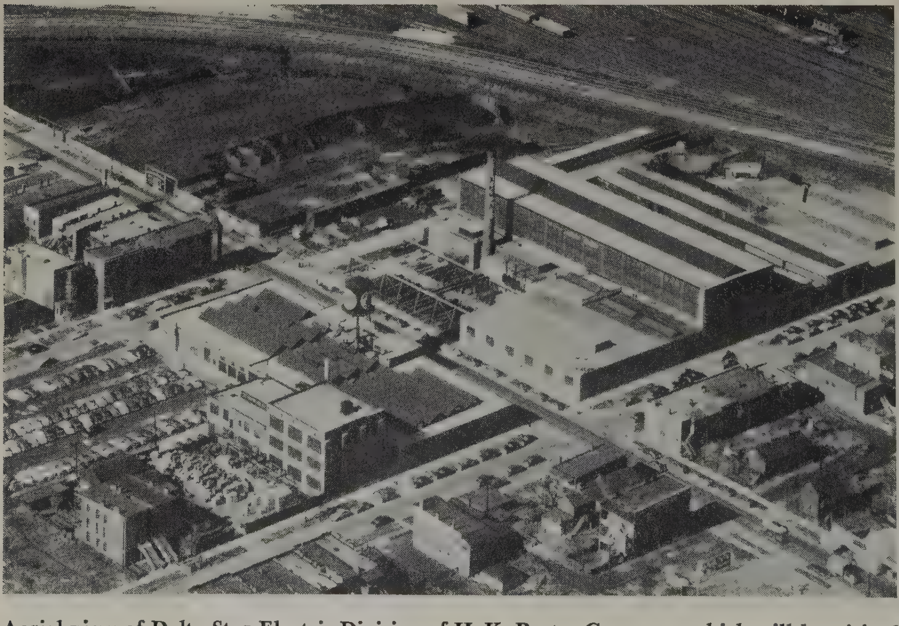
SMOKER

Entertainment events will include a smoker on Tuesday evening, October 12, in the Morrison Hotel. A dinner and a program of entertainment has been planned, to be preceded by a hospitality hour.

Requests for tickets should be addressed to J. A. Romano, c/o Delta-Star Electric Company, 2437 Fulton Street, Chicago 12, Ill., and all requests should be accompanied by a remittance to ensure a reservation. The price is $10.00 per ticket.

INSPECTION TRIPS

Inspection trips will include the Hawthorne plant of the Western Electric Company, where more than half of the world's telephones have been made; the Ridgeland Station and Jefferson Substation of the Commonwealth Edison Company; Delta-Star Electric Division of H. K. Porter Company; Rauland Corporation; Institutes for Basic Research at the University of Chicago; The South Chicago plant of Republic Steel Corporation, and Motorola, Inc.



Aerial view of Delta-Star Electric Division of H. K. Porter Company which will be visited by members attending the Fall General Meeting

Hawthorne Plant. This is the oldest of the Western Electric Company manufacturing plants, starting in 1905 in the midst of what was then surrounding prairie. Since that time it has become one of the largest industries in the area; its tower, its smoke stack, its huge neon sign, "Maker of Bell Telephones," are landmarks known to thousands. Nearly 20,000 people now are employed in the plant.

Hawthorne's main products are: panel, step-by-step, and cross-bar central office equipment, lead-covered and Alpeth exchange cable, copper line wire, loading coils, message registers, automatic message accounting equipment, steel wire and strand, pole line hardware, apparatus cabinets, power boards and fuse panels, keys, jacks, and heat coils.

The plant covers 128 acres of ground and over 4,000,000 square feet of floor space, and has its own telephone exchange, library, stores, power plant, police and fire departments, and restaurants.

Delta-Star Electric Division. A manufacturer of high-tension electric switching equipment, heavy-duty metal-enclosed bus runs, outdoor substations, and allied equipment, the company was founded in 1908 and has been located at the present address since 1912. Its capital stock was purchased in 1950 by the H. K. Porter Company.

The main office and factory in Chicago include a steel fabricating shop, sheet metal shop, galvanizing machine shop, switch assembly, and laboratory. Production machinery consists essentially of metal cutting, forming, drilling, tapping, welding, and heat-treating equipment. Principal equipment includes nonautomatic screw machines, engine lathes, milling machines, drill presses, grinders, welders, shapers, and hydraulic presses up to 700-ton size. Laboratory and test facilities include: a 1,000,000-volt impulse generator, a 500,000-volt 60-cycle transformer bank for dielectric tests, 7,000- and 12,000-ampere 3-phase 60-cycle transformer banks for conducting heat-run tests, a 50,000-pound mechanical testing machine, transformers for short-time current testing at values up to 100,000 rms ampere, and an ice chest for simulating ice conditions on outdoor switches. All items manufactured by Delta-Star are repetitive and tooling is designed for component parts in economical proportion to the quantities to be produced.

Motorola, Inc. Motorola is one of the world's largest radio manufacturers, a leader in the manufacture of 2-way radio communications equipment, and one of the big four television set producers. This plant is unique because of its astonishing growth. At the start of World War II, Motorola was occupying 185,000 square feet of plant area in Chicago. Today it occupies over a million square feet. It is the world's largest independent manufacturer of automobile radios.

Ridgeland Station. The newest and most modern of the 11 electric generating plants of the Commonwealth Edison Company serving Chicago and northern Illinois, the station is located on the Illinois Waterway which provides large amounts of water for condensing purposes and which also provides for the delivery of coal by barge. The station will have an ultimate generating capacity of 600,000 kw. Of particular interest at Ridgeland are the cyclone furnaces with which the boiler furnaces are equipped. Each boiler has four of these furnaces, which together consume approximately 750 tons of coal daily.

The almost limitless reserves of coal in central Illinois and the excellent transportation facilities provided at Ridgeland have made it possible to provide Ridgeland with perhaps the largest coal storage pile in the Middle West. At present space is provided for a reserve stockpile of coal of 900,000 tons.

Production line at Motorola, Inc., which will be inspected during the Fall Meeting

Republic Steel. The visit to the Republic Steel Company plant at South Chicago will provide members with an opportunity to see the complete steel-making operation in a single plant. Republic is the world's largest producer of electric furnace steel, about half of which is made in nine furnaces at the Chicago plant. Incidentally, this plant is one of the largest users of Commonwealth Edison power.

At the Institutes for Basic Research of the University of Chicago, which includes the Institute for Nuclear Studies and the Institute for the Study of Metals, visiting members will see, among other things, the 450-million-electron-volt cyclotron, the 100-million-electron-volt betatron, and the low-temperature laboratory.

Rauland. The Rauland Corporation is of interest in that it has facilities for the mass production of television tubes, as well as many other special tubes and advanced electronic equipment.

HOTEL RESERVATIONS

As mentioned in the August issue (*pp. 745–6*) the Hotel Arrangements Committee urges early requests for hotel reservations. Such requests should be addressed to Convention Department, Morrison Hotel, Madison and Clark Streets, Chicago 2, Ill. AIEE should be mentioned and a copy sent to G. L. Welch, Hotel Arrangements Committee, care of Westinghouse Electric Corporation, Merchandise Mart, Chicago 54, Ill.

Additional Names Announced to List of Members for Life

Membership for life is granted by the AIEE to members who either have paid annual dues for 35 years, or have reached the age of 70 and paid dues for 30 years. A list of those who have become Members for Life as of May 1, 1954, are

Allen, A. J.
Amy, E. V.
Anderson, I.
Anderson, S. H.
Anthony, A. W., Jr.
Arnett, W. W., Jr.
Bacon, V. R.
Bailey, E. H.
Baker, W. R. G.
Ball, F. L.
Barret, C. E.
Barry, R. L.
Bauer, J. H.
Baxter, C. W.
Bean, L. P. R.
Beerstecher, L. H. C.
Bindshedler, T. S.
Boissonnault, F. L.
Bower, G. W.
Brentlinger, C. M.
Brown, S. K.
Brownell, F. A.
Button, H. W.
Callahan, E. S.
Campbell, A. B.
Campbell, T. C.
Cannady, N. E.
Carson, R. B.
Casal, F. M., Jr.
Chadbourn, R. W.
Chamberlain, R. F.
Champ, C. A.
Chapman, F. E.
Charley, R. M.
Clark, A. B.
Clark, J. A.
Clem, J. E.
Cockaday, L. M.
Cole, E. R.
Cole, H.
Coley, W. R.
Collison, G. C.
Condon, E. J., Jr.
Conley, B. L.
Cook, S. S.
Cooley, C. H.
Cooper, M. D.
Corwith, H. P.
Craft, F. M.
Davidson, J.
Davidson, R. J.
Davis, A. H., Jr.
Davis, A. P.
Degen, F. I.
Del'Homme, L. K.
Demarest, C. S.
Doan, G. H.
Dorfman, L. O.
Doughty, W. E.
Dow, W. G.
Dressner, V. D.
Eastham, M.
Edsall, W. S.
Elliott, H. F.
Eriksson, K. E. G.
Evelev, Y.
Ewart, F. E.
Fall, C. B.
Farrer, H. E.
Fitts, J. A.
Floyd, G. D.
Foote, J. H.
Ford, F. R.
Foster, T.
Frantz, L. T.
Frick, C. W.
Funk, F. W.
Gaither, R. H.
Glines, R. B.
Goldhammer, M. H.
Granfield, T. H.
Grondahl, L. O.
Grover, L. E.
Hamilton, R. F.
Harrison, H. C.
Harrison, L. S.
Harvey, H. F., Jr.
Hastings, N. H.
Heinrich, W. A.
Hopkins, Raymond A.
Hotopp, A. H , Jr.
Howe, J. A.
Huntington, M. B.
Hutchison, W. M.
James, L. H.
Johnson, J. H.
Johnstone, D. M.
Jump, G. H.
Karuven, M.
Keene, A. D.
Keesling, H. G.
Kerschner, E.
Kniskern, F. B.
Knotts, C. L.
Kranz, H. E.
Kusner, L.
Landwehr, J. H.
Lane, F. A.
Lange, E. O.
Langstaff, H. A. P.
Lansil, C. E.
Leggett, J. M.
Lippincott, D. K.
Long, M. B.
Loomis, E. W.
Lowry, H. H.
Martindale, R.
Maxstadt, F. W.
McNaught, R. P.
Menke, O. H.
Meyer, H. W.
Milbyer, J. H.
Miller, C. E.
Miller, J. H.
Moore, J. H.
Moore, S. E.
Narayan, S.
Neal, G. A.
Newcomb, T.
Noble, P. O.
Norris, F. W.
Oswald, A. A.
Parrott, D. F.
Paterson, A. J.
Pearl, A. S.
Pierce, N. C.
Pierce, R. E.
Platt, C. J., Jr.
Plumb, H. H.
Polstrock, L. B.
Pool, R. Y.
Poole, F. L.
Potter, C. P.
Price, G. F.
Putnam, R. E. A.
Rinker, R. L.
Roe, R. C.
Rose, A. F.
Russell, S. P.
Sadler, E. K.
Salsbury, R. J.
Sanderson, W. D.
Schwenk, A. B.
Seeley, A. P.
Seeley, W. J.
Seelye, H. P.
Semrad, C. A.
Shackleton, S. P.
Shaw, J. S.
Siegmund, H. O.
Sinelnick, H. B.
Slocum, H. R.
Smeloff, N.
Smith, H. L.
Smith, J. J.
Smith, W. R.
Spencer, M. C.
Steinmayer, A. G.
Stetler, F. E.
Stickney, H. R.
Storrow, J. J.
Streiff, A.
Swenson, G. W.
Terry, C. A.
Thalheimer, J. J.
Tompkins, F. N.
Tykociner, J. T.
Vernam, G. S.
Henline, H. H.
Hickey, C. E.
Higgins, N. B.
Hight, W. R.
Hinson, N. B.
Hoard, G. L.
Hodgins, L. J.
Hoeppner, H. L.
Hoisington, N. P.
Holbrook, H. S.
Holderness, H. C.
Holman, H. R.
Holmgren, E. L.
Hookway, C. W.
Hopkins, R. A.
Vilstrup, A.
Waldinger, H.
Watson, E. F.
Way, D. D.
Wells, W. E.
Weppler, H. S.
Werner, H. G.
Wheelock, F. O.
Whitmore, C.
Williamson, A. G.
Winterer, H. K.
Withington, S.
Wyckoff, H. J.
Young, R. L.
Yountz, J. P.

AIEE to Participate in Instrument Congress

The AIEE Committee on Instruments and Measurements will sponsor two sessions at the First International Instrument Congress and Exposition to be held at the Commercial Museum and Convention Hall in Philadelphia, Pa., September 13–24, 1954. The congress will run concurrently with the Ninth Annual Meeting of the Instrument Society of America (ISA) in co-operation with a number of technical societies, including the AIEE.

Members of participating societies can attend all technical sessions without payment of a fee. The exhibit, which will feature some 450 domestic and foreign exhibitors, is free. It will run from September 15 to 21.

Of interest to AIEE members might be the Analytical Instrument Clinic, a lecture and demonstration course on the latest and most advanced analytical instruments, to be held September 13–15. Registration forms may be obtained from Dr. Alex H. Peterson, Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa. Also, the ISA Instrument Maintenance Clinic, to begin on Friday, September 17, for a total of nine 2-hour sessions, will offer instruction in maintenance of various basic types of instruments. It is open to members of the co-operating societies without charge but advance registration is requested, through P. V. Jones, Jr., Manager, Instrument Society of America, 1319 Allegheny Avenue, Pittsburgh 33, Pa.

A joint luncheon of the AIEE Instruments and Measurements Committee with The American Society of Mechanical Engineers and the American Institute of Physics will be held on Tuesday, September 14. All reservations must be made by the evening of September 13.

The AIEE-sponsored sessions at the congress will be as follows:

Thursday, September 16

9:30 a. m.

Sheet and Plated-Metal Measurements With a Phase-Angle-Type Probe. *W. A. Yates, J. L. Queen*

The Quasi-Peak Voltmeter. *C. W. Frick*

Thickness Gauge for Dielectric Materials. *W. W. Woods*

A Survey of Noncontacting Vibration Pickups Using Electric Fields. *H. F. Clarke*

2:30 p.m.

A Tungsten Resistance Thermometer. *F. R. Sias, J. R. MacIntyre, A. Hansen*

A Simplified Standard Cell Comparator, *J. H. Miller*

A New 12-Element Automatic Oscillograph and Applications on the Bonneville Power Systems. *C. M. Hathaway, W. L. Davis, J. R. Curtin*

An Air-borne Temperature Indicator. *W. R. Clark, W. G. Amey, G. C. Mergner*

Spokane Section Installs Chairman

The retiring chairman of the AIEE Spokane Section, Charles Uhden (right), Kaiser Aluminum and Chemical Corporation, hands the gavel to the incoming chairman, H. C. Martindale, Westinghouse Electric Corporation, during the installation of officers at the annual dinner-dance meeting. The Section reports a successful first year for its Wenatchee Subsection, highlighted by a field trip to the new Moses Lake sugar refinery of the U. and I. Sugar Refining Company

Information Theory Symposium to Be Jointly Sponsored at MIT

The 1954 Symposium on Information Theory will be held at the Massachusetts Institute of Technology (MIT), Cambridge, Mass., September 15–17. This symposium is sponsored by AIEE, Research Laboratory of Electronics at MIT, Institute of Radio Engineers (IRE), the International Scientific Radio Union (URSI), the Office of Naval Research, the Air Research and Development Command, and the Signal Corps Engineering Laboratories.

Seventeen papers will be presented, reporting new results and applications of information theory in the areas of detection, prediction, organization, coding, and retrieval of information. Authors have been instructed to minimize the review and tutorial content of their papers on the assumption that those attending the symposium will be familiar with information theory.

A banquet will be held at the MIT Faculty Club on Thursday evening, September 16, the cost of which will be $3.50.

Transactions of the symposium will be published in advance and the cost is $5.00 to AIEE and IRE members and $10.00 to nonmembers.

For registration, Transactions order form, etc., write to Professor R. M. Fano, Room 20 A 118, Massachusetts Institute of Technology, Cambridge 39, Mass.

Wednesday, September 15

9:00 a.m. Registration

9:45 a.m. Opening Remarks

R. M. Fano, Research Laboratory of Electronics, MIT

10:00 a.m. Coding I

Chairman: J. B. Wiesner, Research Laboratory of Electronics, MIT

Some New Basic Results in Information Theory. *A. Feinstein*

Binary Coding. *M. J. E. Golay*

Error-Free Coding. *P. Elias*

2:00 p.m. Coding II

Chairman: W. G. Tuller, Malpar, Inc.

A Class of Multiple-Error Correcting Codes and the Decoding Scheme. *I. S. Reed*

Coding for Fixed Data Rate Systems. *R. A. Silverman, M. Balser*

Thursday, September 16

9:30 a.m. Information and Organization

Chairman: B. McMillan, Bell Telephone Laboratories

Information, Organization and Systems. *J. Rothstein*

An Information-Theoretic Model of Organizations. *M. Kochen*

Simulation of Self-Organizing Systems by Digital Computer. *B. G. Farley, W. A. Clark*

2:00 p.m. Analysis and Retrieval of Information

Chairman: L. A. deRosa, Federal Telecommunications Laboratories

A Study of Ergodicity and Redundancy Based on Intersymbol Correlation of Finite Range. *S. Watanabe*

Multivariate Information Transmission. *W. J. McGill*

Choice and Coding in Information Retrieval Systems. *C. N. Mooers*

7:00 p.m. Banquet

Dr. Norbert Wiener, after-dinner speaker

Friday, September 17

9:30 a.m. Detection and Prediction I

Chairman: E. Weber, Polytechnic Institute of Brooklyn

Modern Statistical Approaches to Reception in Communication Theory. *D. Van Meter, D. Middleton*

A Nonlinear Prediction Theory. *R. F. Drenick*

The Detection of Signals Perturbed by Scatter and Noise. *R. Price*

2:00 p.m. Detection and Prediction II

Chairman: L. G. Abraham, Bell Telephone Laboratories

The Theory of Signal Detectability. *W. W. Peterson, T. G. Birdsal, W. C. Fox*

The Human Use of Information. I—Signal Detection for the Case of the Signal Known Exactly. *W. P. Tanner, Jr., W. A. Swets*

The Human Use of Information. II—The Problem of Simultaneous Versus Independent Observation When There Is Uncertainty in One of the Signal Parameters. *W. P. Tanner, Jr., R. Z. Norman*

Lamme Medal Nominations Must Be Submitted by December 1

Members of the Institute again are reminded that they have an opportunity to submit nominations for the 1954 Lamme Medal. All nominations must be received not later than December 1, 1954.

Details regarding qualifications for the award were published in the June 1954 issue of *Electrical Engineering*, page 566.

Program Is Announced for 1954 Machine Tool Conference

The seventh annual AIEE Conference on Machine Tools will be held in Detroit, Mich., October 25–27, 1954, under the direction of Kurt O. Tech, chairman of the AIEE Machine Tool Subcommittee. Headquarters for the conference will be at the Statler Hotel.

The threefold theme of the conference will deal with automation, maintenance, and future trends in the machine tool industry. An excellent technical program has been arranged featuring subjects of vital interest and speakers who are recognized authorities in their respective fields. A variety of interesting plant tours has also been arranged to round out the program.

The banquet speaker will be Kenneth McFarland, educational director of the General Motors Corporation. The luncheon speaker will be Dr. Henry Gomberg, assistant director of the Michigan Memorial-Phoenix Project at the University of Michigan.

Following is the program for the 3-day conference:

Monday, October 25

10:00 a.m. Registration

1:30 p.m. Session I

Chairman: E. E. Opel, National Automatic Tool Company

Automation Today. *P. H. Alspach*, General Electric Company

Automation. *R. E. Cross*, The Cross Company

Standard Automation and Inspection Equipment. *M. M. Arlin*, Arlin Products, Inc.

Automation Maintenance. *N. K. Conrad*, Ford Motor Company

7:00 p.m. Banquet

"The U in Industry," by Kenneth McFarland, General Motors Corporation

Tuesday, October 26

8:30 a.m. Plant Visits

Ford Motor Company

U. S. Rubber Company

12:30 p.m. Luncheon

"Peacetime Applications and Implications of Atomic Energy," by Dr. Henry Gomberg, University of Michigan

2:00 p.m. Session II

Chairman: F. L. Fisher, Allen-Bradley Company

Techniques in Failure Prevention. *J. H. Hosmer*, Allis-Chalmers Manufacturing Company

A Preventive Maintenance System and Its Execution. *L. P. Randall, Sr.*, General Motors Corporation

Record Playback Control of a Hypro Skin Mill. *H. E. Ankeney*, Giddings and Lewis Machine Tool Company; *J. L. Ducher*, General Electric Company

Wednesday, October 28

9:00 a.m. Session III

Chairman: E. L. Behringer, Micromatic Hone Corporation

Project Tinkertoy. U.S. Navy motion picture

Increasing Reliability of Industrial Electronic Controls. *A. V. Wise*, *J. W. Picking*, Reliance Electric and Engineering Company

Electric Clutches—Panel: *H. B. Stallings*, I-T-E Circuit Breaker Company; *J. B. Brown, Jr.*, Warner Electric Brake and Clutch Company; *W. G. Martin*, Vickers Electric Division

1:00 p.m. Plant Visits

Detroit Transmission Division, General Motors Corporation

Greenfield Village, Ford Motor Company

Ex-Cell-O Corporation

COMMITTEE ACTIVITIES

Editor's Note: This department has been created for the convenience of the various AIEE technical committees and will include brief news reports of committee activities. Items for this department, which should be as short as possible, should be forwarded to R. S. Gardner at AIEE Headquarters, 33 West 39th Street, New York 18, N. Y.

Note. Because of the changeover in committee personnel, no items on committee activities are included in this issue.

AIEE PERSONALITIES.....

E. C. Starr (M'29, F'41), professor of electrical engineering, Oregon State College, Corvallis, has been appointed chief engineer, Bonneville Power Administration, Portland, Oreg. A native of Oregon, Mr. Starr received his bachelor of science degree in 1923 and his electrical engineering degree in 1938 from Oregon State College, and has taught there continuously since 1927. Prior to teaching at Corvallis, he took the graduate engineer course of the General Electric Company and served for a year as a high-voltage engineer. Since 1939 Mr. Starr has served as consultant engineer for Bonneville Power Administration with particular reference to transmission economics, series- and shunt-capacitor applications, circuit-breaker applications, high-voltage and system protection practices, system stability, generator and synchronous condenser characteristics, nuclear reactors for power production, and high-voltage transmission. During World War II, he served in the Office of Scientific Research and Development, being assigned to aircraft radio research. He is currently a consultant to the Reactor Development Division, U. S. Atomic Energy Commission. He was a civilian scientific observer at the Bikini atomic bomb tests in 1946. Mr. Starr is a member of the American Association for the Advancement of Science, Institute of Radio Engineers, Sigma Xi, Phi Kappa Phi, Sigma Tau, Eta Kappa Nu, and Tau Beta Pi. He has served on the following AIEE committees: Research (1941–43); Transmission and Distribution (1944–54); Basic Sciences (1951–54); and Sections (1953–54).

G. C. Neff (M'16), president, Wisconsin Power and Light Company, Madison, retired August 1, 1954. He will continue as chairman of the company's board of directors. A native of Milford, Ind., he joined the engineering firm of Meade and Seastone in 1908, after graduation from Purdue University. Later he became superintendent of the Kilbourn (Wis.) hydroelectric plant, and then general superintendent of the Wisconsin River Power Company which owned the Prairie du Sac hydroelectric plant. In 1924 Mr. Neff was elected vice-president of the newly formed Wisconsin Power and Light Company. He was named president in 1933. Mr. Neff served as president of the Edison Electric Institute in 1946–47. In 1951 he was honored with a Distinguished Service Citation from the University of Wisconsin, and in 1952 received an honorary doctors degree from Purdue University.

E. C. Starr

G. C. Neff

O. P. Cleaver (AM'36, M'48), chief, electrical engineering department, Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va., has received an "outstanding" rating for exceptional performance of every phase of his work during 1953. Through his efforts a program for the standardization of components of engine-generator sets was initiated. Mr. Cleaver also guided and directed notable achievements in the field of illumination and was instrumental in significant advancements made in mine detection and infrared programs. A native of Rowletts, Ky., Mr. Cleaver was graduated from Georgia Institute of Technology in 1928 with a degree in electrical engineering and 2 years later received his masters degree from Yale University. A reserve lieutenant colonel, Mr. Cleaver served with the Engineer Board (now Engineer Research and Development Laboratories) during World War II. He remained with the laboratories in a civilian capacity following his release from active duty in 1946. Mr. Cleaver is a fellow of the Illuminating Engineering Society and has served on the AIEE Committee on the Production and Application of Light (1940–42).

D. B. Breedon (AM'51) and **L. F. Stringer** (AM'48), engineers at the East Pittsburgh, Pa., plant of Westinghouse Electric Corporation, have been awarded the Benjamin Garver Lamme Graduate Scholarships for 1954–55. Mr. Breedon intends to study for his doctorate in the field of computers and their application at Massachusetts Institute of Technology, Cambridge. He received his bachelor of electrical engineering degree in 1948 from Ohio State University and his master of science in electrical engineering degree from Illinois Institute of Technology in 1950. He joined Westinghouse in 1950 and is a computer designer in the analytical section. Mr. Stringer was graduated in 1946 from the University of Texas with a bachelor of science in electrical engineering degree. He received his masters degree from California Institute of Technology in 1947. He served 36 months with the U. S. Navy in World War II before joining Westinghouse in 1947. He is currently in industry engineering. Mr. Stringer plans to study for his doctorate at either Massachusetts Institute of Technology or the University of Pittsburgh in the field of engineering mathematics. He is serving on the AIEE Committee on Feedback Control Systems (1953–54).

Alan Howard (AM '28, M '35), manager of engineering, medium steam turbine, generator, and gear department, General Electric Company, Lynn, Mass., has received the honorary degree of doctor of engineering from Purdue University. Mr. Howard was honored for his contributions to the design and development of turbines for aircraft, locomotives, power generation, and natural-gas pipe-line pumping. A native of Washington, D. C., Mr. Howard received his bachelor of science degree from Purdue in 1927. He joined General Electric that year and after 3 years of training in the advanced course in engineering, he was placed in charge of this training work. In 1935, he joined the Turbine Division, working on mercury and steam turbines, steam-electric locomotives, and in preliminary gas-turbine studies for 5 years. In the period from 1940 to 1946 Mr. Howard was responsible for the design and development of the *TG-100*, the world's first aircraft gas turbine for propeller drive, and the *TG-180* jet unit. For this work he received the Coffin Award. In 1946 Mr. Howard became engineer in charge of development of all General Electric nonaircraft gas turbines. In 1951 he became general manager of the gas turbine department, Schenectady, N. Y., and in 1952 attained the position of manager of the engineering department of the Turbine Division. On April 1, 1954, he was promoted to his current post. He is a member of The American Society of Mechanical Engineers and has served on the AIEE Committee on Education (1934–36).

H. E. Turner (AM '26, M '41), vice-president and general manager, Ohio Power Company, Canton, has been named executive vice-president, American Gas and Electric Service Corporation, New York, N. Y. Mr. Turner, a native of Canada, was graduated from the University of Toronto in 1924. He joined American Gas and Electric in 1926 as an engineer. By 1934 he was assistant to the vice-president and chief engineer. In 1941 he was named assistant general manager of Ohio Power and was elevated to vice-president and general manager in 1946. One of the founders of the Ohio Electric Utility Institute, he served as its first president. He has served on the AIEE Committee on Protective Devices (1934–36).

W. G. Claytor (AM '10, F '46, Member for Life), executive vice-president in charge of operations, American Gas and Electric Service Corporation, New York, N. Y., retired June 30, 1954. He will continue, however, as a member of the company's board of directors and of the board's executive committee. Graduated from Virginia Polytechnic Institute in 1906, Mr. Claytor joined the engineering staff of the Roanoke (Va.) Railway and Electric Company. By 1922 he was assistant general manager of the electric companies serving both Roanoke and Lynchburg, Va., owned by the American Electric Power Company. In 1923 he was named chief engineer of American Electric Power Company and 2 years later was appointed general manager. When American Electric Power was acquired by American Gas and Electric in 1926, Mr. Claytor was transferred to New York and named operating vice-president of several of the operating subsidiaries. When the Service Corporation was formed in 1937 he was elected operating vice-president and director. He was elected vice-president of American Gas and Electric in 1943, a director in 1944, a member of the executive committee in 1951. He became executive vice-president of the Service Corporation in December 1953. He also is a vice-president and director of all American Gas and Electric operating companies as well as a number of other smaller subsidiaries. Mr. Claytor has served on the AIEE Board of Examiners (1951–52).

A. N. Prentice (M '45), assistant general manager, Ohio Power Company, Canton, has been named vice-president and general manager. Mr. Prentice was graduated from Case Institute of Technology and started with Ohio Power as an engineer in 1928. By 1934 he was assistant general meter superintendent, by 1937 general engineer, and by 1944 managerial assistant. He became assistant to the vice-president and general manager in 1949; assistant general manager of another American Gas and Electric company, the Indiana and Michigan Electric Company, Fort Wayne, Ind., in 1950, and assistant general manager of Ohio Power in October 1953. He is a director of Ohio Power and American Gas and Electric Service Corporation.

John Gammell (AM '38, M '45), supervisor of sales training, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has been appointed director of graduate training. Mr. Gammell came to Allis-Chalmers in 1928 and was assigned to the company's Philadelphia, Pa., office in 1934 as a sales representative. From 1941 to 1944 he was chief of the electrical equipment branch of the War Production Board, Washington, D. C., after which he returned to the Philadelphia office. He has been supervisor of sales training since 1949. Mr. Gammell is a member of The American Society of Mechanical Engineers and has served on the AIEE Committees on Transfers (1947–50) and General Industry Applications (1949–50).

OBITUARIES • • • •

Cornelius Godfrey Brennecke (AM '39, M '46, F '51), professor and head of the electrical engineering department, North Carolina State College, Raleigh, died August 2, 1954. Dr. Brennecke was born in New York, N. Y., August 29, 1906. He received his bachelors degree from Columbia and his doctorate from New York University in 1936. From 1936 to 1942 Dr. Brennecke served successively as instructor, assistant professor, and associate professor of electrical engineering, University of Toledo, Ohio. During 1941–42, he organized and directed the school for training technical aides for the U. S. Army Signal Corps. From 1942 to 1945 he was associate professor of electrical engineering, Lehigh University, Bethlehem, Pa. Since 1945 he had been professor and head of the electrical engineering department, North Carolina State College. In 1949 he was appointed North Carolina State College representative on the Oak Ridge (Tenn.) Institute of Nuclear Studies. He was for 3 years a design engineer for the Radio Corporation of America and had done extensive research in such fields as conduction of electricity through dielectrics and on electronic devices for increasing mining safety. Dr. Brennecke was a fellow of the Institute of Radio Engineers, and a member of the American Society for Engineering Education, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu. He had served on the AIEE Committees on Basic Sciences (1953–54) and Education (1953–54).

Albert Armstrong Nims (AM '11, M '28, F '53, Member for Life), electrical engineering department, Union College, Schenectady N. Y., died recently. Mr. Nims was born in Montague, Mass., August 1, 1886, and was graduated from Worcester Polytechnic Institute in 1908 with a bachelor of science degree in electrical engineering. He received the electrical engineering degree from the same institution in 1911. Mr. Nims was design engineer for the Crocker Wheeler Company, Ampere, N. J., from 1912 to 1919. He was engineer-in-charge of design and construction for the Siemund Wenzel Electric Welding Company, New York, N. Y., from 1919 to 1922. In 1908 he began his teaching career as part-time assistant instructor at Worcester (Mass.) Polytechnic Institute; in 1917 he resumed his teaching of engineering as night school instructor at The Cooper Union, New York, N. Y. In 1918 he began, as an evening instructor, his long engineering-teaching career at Newark (N. J.) Technical School and Newark College of Engineering. In 1922 he left industry for full-time teaching at Newark College of Engineering. He was made chairman of the electrical engineering department in 1946, a post which he held until his retirement in 1952. Mr. Nims joined the staff of the department of electrical engineering at Union College early in 1953. He was a member of the American Society for Engineering Education, Tau Beta Pi, and Sigma Xi.

David Spencer Wegg (AM '08, M '20, Member for Life), engineer, Stone and Webster Engineering Corporation, Boston, Mass., died June 24, 1954. Mr. Wegg was born in Milwaukee, Wis., February 8, 1887, and graduated from Cornell University in 1912. From 1905 to 1916 he worked with Telluride Power Company in Utah, Colorado, and Wyoming, holding positions from shiftman to assistant general manager of the Beaver River Power Company, a subsidiary. During World War I he was a civilian supervising inspector, U. S. Army Ordnance Chicago, Ill., District Office. From 1920 to 1925 he was engineer with Gilchrist and Company, Chicago, and from 1925 to 1928 was assistant chief, Electrical Equipment Division, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, D. C. In 1928 he joined Electric Bond and Share Company, New York, N. Y., and had the engineering supervision of their properties in Brazil. Mr. Wegg was engineer with American Cyanamid Company, New York, N. Y., for 3 years and then was chief engineer of Consolidated Laundries Corporation, New York, for 5 years. In 1938 he joined American Writing Paper Corporation, Holyoke, Mass. Before joining Stone and Webster Corporation in 1947, he was with Jackson and Moreland, Boston. Mr. Wegg was a member of The American Society of Mechanical Engineers and the National Association of Power Engineers.

Sasha Samuel Headman (M '25), partner, Headman, Ferguson, and Carollo, Tucson, Ariz., died May 22, 1954. Mr. Headman was born in San Francisco, Calif., August 10, 1887, and was graduated from the University of California with a bachelor of science degree in electrical engineering in 1909. A veteran of World War I, he came to Arizona about 1920, having previously worked for various firms in California. He first worked with the Tucson Gas, Electric Light, and Power Company and then in 1927 became a construction engineer for Federal Light and Power Company. He formed his partnership in 1932. Mr. Headman was a member of The American Society of Mechanical Engineers and the Arizona Society of Professional Engineers. He was instrumental in the formation of the Arizona Section of the AIEE and had served on the Committee on Industrial Power Applications (1944–46).

William Taylor Poulterer (AM '38), electrical sales engineer, Simplex Wire and Cable Company, New York, N. Y., died July 26, 1954. Mr. Poulterer was born in Philadelphia, Pa., July 14, 1888, and attended Harvard University. From 1905 to 1919 he was associated with the Philadelphia (Pa.) Electric Company in various capacities. In 1920 he became engineer and sales manager for the Electrical Development and Machine Company, Philadelphia. From 1926 to 1936 he held positions in the following companies: Iroquois Electric Refrigeration, Philadelphia; American Brown Boveri Company, Camden, N. J.; Condit Electric Manufacturing Company, Boston, Mass; General Commercial Lithograph Corporation, Philadelphia; and Radio Corporation of America, Camden. He had been associated with Simplex Wire and Cable since 1936.

Gordon L. Kleinhammer (AM '53), engineer, Automatic Electric Company, Chicago, Ill., was killed in an automobile accident while returning from vacation on June 24, 1954. Mr. Kleinhammer was born in Dodgeville, Wis., September 30, 1928, and was graduated from the University of Wisconsin in 1950 with a bachelor of science degree in mechanical engineering. After graduation he went to work for Automatic Electric Company for a year, and then entered the U. S. Air Force. He was discharged in 1953 with the rank of first lieutenant and returned to Automatic Electric as an engineer in their testing bureau.

Alexander Skene Moody (AM '09, Member for Life), retired, Portland, Oreg., died May 6, 1954. Mr. Moody was born November 19, 1883, at Lake George, N. B., Canada, and was graduated from the University of California in 1906 with a bachelor of science degree. He started with the Stanley Company in San Francisco, Calif., in 1906, which was then owned by the General Electric Company. In 1908 he was transferred to Seattle, Wash., by General Electric, and in 1910 was made manager of the supply department in Portland, Oreg. In 1923 he went to Los Angeles, Calif., as manager, and in 1924 was made northwest manager. He was commercial vice-president in charge of the Pacific Northwest District when he retired in November 1948.

MEMBERSHIP • • •

Recommended for Transfer

The Board of Examiners at its meeting of July 15, 1954, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the Secretary of the Institute. A statement of valid reasons for such objections, signed by a member, must be furnished and will be treated as confidential.

To Grade of Member

Allen, S. R., electrical engr., Bonneville Power Administration, Portland, Oreg.
Baird, F. E., transmission & protection engr., Northwestern Bell Tel. Co., Des Moines, Iowa
Bauer, C. A., supervising design engr., Commonwealth Edison Co., Chicago, Ill.
Boone, W. A., transmission line engr., Alabama Power Co., Birmingham, Ala.
Bross, R. B., consulting engr., 25 Curtis Rd., Natick, Mass.
Christian, D. R., engr. consultant, Clevite Brush Development Co., Cleveland, Ohio
Coho, O. C., electrical engr., General Electric Co., Erie, Pa.
Colbert, L. H., partner, Harry J. Fisher Associates, Cleveland, Ohio
Cunningham, R. C., dept. mgr., atomic power div., Westinghouse Electric Corp., Pittsburgh, Pa.
Darden, T. N., electrical field engr., General Electric Co., Atlanta, Ga.
Darr, J. E., section mgr., Westinghouse Electric Corp., Friendship Intl. Airport, Md.
Davis, F. H., electrical engr., Bonneville Power Administration, Portland, Oreg.
Deltoro, V., asst. prof., City College of New York, N. Y.
Doerrie, C. C., engg. & service supervisor, Westinghouse Electric Corp., Des Moines, Iowa
Ellsworth, H. C., engr., General Electric Co., Richland, Wash.
Ericksen, H. N., operating mgr., Nebraska Public Power System, Columbus, Nebr.
Ferdinandus, J. H., engr., Southern New England Telephone Co., New Haven, Conn.
Fletcher, J. F., senior electrical engr., Flinn, Fletcher, Humphrey, Inc., Memphis, Tenn.
Flocken, R. J., design engr., General Electric Co., Pittsfield, Mass.
Forberg, T., electrical engr., Voorhees, Walker, Foley & Smith, A. E., New York, N. Y.
Galbraith, B., owner & manager, Virginia Armature Co., Roanoke, Va.
Garner, G. L., general traffic engr., Southern New England Telephone Co., New Haven, Conn.
Gartland, R. J., staff engr., The Chesapeake & Potomac Telephone Co., Washington, D. C.
Gradasoff, L. I., chief, station plans unit, Bonneville Power Administration, Portland, Oreg.
Greer, T. M., electrical engr., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Gustafson, R. W., heating control supv., General Electric Co., Morrison, Ill.
Hally, H. G., supv. engr., overhead lines, Iowa Power & Light Co., Des Moines, Iowa.
Halsey, G. H., development engr., General Electric Co., Pittsfield, Mass.
Hanuschak, M., electrical engr., The Peerless Electric Co., Warren, Ohio
Hartley, R. H., consulting & application engr., Westinghouse Electric Corp., Phoenix, Ariz.
Hartman, C. J., Sr., substation design engr., Commonwealth Associates, Inc., Jackson, Mich.
Hendrickson, C. R., system planning engr., Omaha Public Power District, Omaha, Nebr.
Hicks, H. S., asst. chief engineer, H. N. Roberts & Associates, Lubbock, Tex.
Homan, C. C., Jr., asst. executive engr., El Paso Natural Gas Co., El Paso, Tex.
Hubbard, E. F., electrical engr., Keith Electric Construction Co., Des Moines, Iowa
James, H. B., design engr., Westinghouse Electric Corp., Lima, Ohio
Jarzembski, W. B., president, Jarco Services, Tulsa, Okla.
Jones, H., district transformer specialist, General Electric Co., Detroit, Mich.
Kibler, J. B., Jr., senior equipment engr., Southwestern Bell Tel. Co., Oklahoma City, Okla.
Kirkbride, C. R., Jr., asst. director of engg., Kuhlman Electric Co., Bay City, Mich.
Knowles, R. W., elec. engr., General Electric Co., Pittsfield, Mass.
Lanoue, R. O., district mgr., Locke dept., General Electric Co., Boston, Mass.
Levine, B., vice-pres., director of engg., Ketay Mfg. Corp., New York, N. Y.
Maleck, J. C., mgr., apparatus service shop, General Electric Co., Johnstown, Pa.
Marie, C. S., engr., Westinghouse Electric Corp., Baltimore, Md.
Mathews, W. E., chief elec. engr., Aluminum Co. of America, Wenatchee, Wash.
Miller, D. R., engr., Portland General Electric Co., Portland, Oreg.
Mirsch, J. W., apparatus repair specialist, General Electric Co., Baltimore, Md.
Murdock, G. W., asst. elec. engr., Pennsylvania Electric Co., Johnstown, Pa.
Oliver, J. P., engr., National Carbon Co., Cleveland, Ohio
Opel, L. G., DC motor design engr., Westinghouse Electric Corp., Buffalo, N. Y.
Ordung, P. F., assoc. prof. of elec. engg., Dunham Lab., Yale University, New Haven, Conn.
Parker, H. B., electrical engr., Black & Veatch, C. E., Kansas City, Mo.
Pennypacker, H. N., assoc. electrical engr., Water & Power Dept., City of Los Angeles, Calif.
Peterson, W. C., asst. prof. of electrical engg., Michigan State College, East Lansing, Mich.
Pfuntner, R. A., supervisor, instrument transf. dev., General Electric Co., Lynn, Mass.
Pool, V. R., electrical engr., Tennessee Valley Authority, Knoxville, Tenn.
Prevey, W. H., mgr., wire & cable dept., Canadian General Electric Co., Toronto, Ont., Canada
Richards, A. T., supervising engr., Westinghouse Electric Corp., Sharon, Pa.
Rogers, E. K., chief electrical engr., Scovill Mfg. Co., Waterbury, Conn.
Rothauge, C. H., assoc. prof. of electrical engg., U. S. Naval Postgraduate School, Monterey, Calif.
Russell, W. A., manager, S. E. Iowa Cooperative Electric Assn., Mt. Pleasant, Iowa
Sargent, F. L., electrical design engr., Black & Veatch, Kansas City, Mo.
Sauter, M. H., electrical engg. supervisor, General Electric Co., Pittsfield, Mass.
Schoenberg, M. S., group project engr., Greer Hydraulics Inc., Brooklyn, N. Y.
Shuman, N., electrical designer, Philadelphia Electric Co., Philadelphia, Pa.
Silverio, V. J., requisition engr., General Electric Co., Philadelphia, Pa.
Spurlock, H. G., district engr., Southern Bell Tel. & Tel. Co., Birmingham, Ala.
Stancl, W. E., professional engr., Commonwealth Associates, Inc., Jackson, Mich.
Swingle, T. M., asst. chief, communication engg. branch, Tennessee Valley Authority, Chattanooga, Tenn.
Tarkenton, C. G., asst. supt., trans. & distr. dept., Delaware Power & Light Co., Wilmington, Del.
Teasdale, R. D., asst. to director of engg. & development, Magnetic Metals Co., Camden, N. J.
Turner, E. N., supervising engr., General Electric Co., Pittsfield, Mass.
Vaclavik, F. J., professional electrical engr., Commonwealth Associates, Inc., Jackson, Mich.
Vodar, J., Jr., asst. electrical supt., E. I. du Pont de Nemours & Co., Charleston, W. Va.
Wallace, F. C., design engr., Black & Veatch, C. E., Kansas City, Mo.
Watson, B. P., design engr., American Machine Development Corp., Richmond, Va.
White, J. C., development engr., General Electric Co., Schenectady, N. Y.
Winglar, W., electrical engr., J & G Daverman Co., Grand Rapids, Mich.
York, M. M., New England regional mgr., Allis-Chalmers Mfg. Co., Boston, Mass.

80 to grade of Member

Applications for Election

Applications for admission or re-election to Institute membership, in the grade of Member, have been received from the following candidates, and any member objecting to election should supply a signed statement to the Secretary before September 25, 1954, or November 25, 1954, if the applicant resides outside of the United States, Canada, or Mexico.

To Grade of Member

Bowen, S. T., Cleveland Electric Illuminating Co., Cleveland, Ohio
Cyr, E. L., City of Newark, Newark, N.J.
Gerlicz, O., Gilbert Associates, Inc., New York, N.Y.
Jones, A. R. (re-election), Canadian General Elec. Co., Peterborough, Ont., Canada
Poritsky, H., General Electric Co., Schenectady, N.Y.
Raju, B. V., Government Cement Factory, Kankesanturai, Ceylon
Van Tassel, E. K., Bell Telephone Laboratories, Murray Hill, N.J.
Wright, H. J., Aden Petroleum Refinery Ltd., Aden, Aden

8 to grade of Member

AIEE Officers and Committees for 1954-55

PRESIDENT

A. C. MONTEITH
Pittsburgh, Pa.
(Term expires July 31, 1955)

PAST PRESIDENTS

Donald A. Quarles, Washington, D. C.
(Term expires July 31, 1955)

Elgin B. Robertson, Dallas, Tex.
(Term expires July 31, 1956)

VICE-PRESIDENTS

District	
2	W. B. Morton, Allentown, Pa.
4	C. P. Almon, Jr., Chattanooga, Tenn.
6	A. S. Anderson, Denver, Colo.
8	G. C. Tenney, San Francisco, Calif.
10	G. D. Floyd, Toronto, Ont.

(Terms expire July 31, 1955)

District	
1	G. J. Crowdes, Cambridge, Mass.
3	J. P. Neubauer, New York, N. Y.
5	C. M. Summers, Fort Wayne, Ind.
7	S. M. Sharp, Shreveport, La.
9	J. R. Walker, Billings, Mont.

(Terms expire July 31, 1956)

DIRECTORS

F. R. Benedict, Boston, Mass.
R. F. Danner, Oklahoma City, Okla.
D. D. Ewing, Lafayette, Ind.
(Terms expire July 31, 1955)

A. C. Muir, Philadelphia, Pa.
J. H. Foote, Jackson, Mich.
C. S. Purnell, New York, N. Y.
(Terms expire July 31, 1956

D. I. Cone, San Francisco, Calif.
T. M. Linville, Schenectady, N. Y.
E. W. Seeger, Milwaukee, Wis.
(Terms expire July 31, 1957)

L. F. Hickernell, Hastings-on-Hudson, N. Y.
R. E. Kistler, Seattle, Wash.
E. S. Lammers, Jr., Atlanta, Ga.
(Terms expire July 31, 1958)

TREASURER

Walter J. Barrett, Newark, N. J.
(Term expires July 31, 1955)

SECRETARY

N. S. Hibshman, New York, N. Y.
(Term expires July 31, 1955)

LOCAL HONORARY SECRETARIES

Australia—V. J. F. Brain, Electricity Authority of N.S.W., Box 2600 G.P.O., Sydney, New South Wales

Brazil—W. L. Simpson, São Paulo Light and Power Company, Caixa Postal 8026, São Paulo

England—Sir A. P. M. Fleming, Metropolitan Vickers Electric Company, Trafford Park, Manchester 17

India, Northern—S. S. Kumar, P.W.D. Electricity Secretariat, Ellerslie, Simla-E, East Punjab

India, Southern—M. S. Thacker, Indian Institute of Science, Bangalore 3

Ireland—Gerard M. Mulhern, Transmission Dept., Electricity Supply Board, 27 Lower Fitzwilliam Street, Dublin

Japan—Stetfan Tanabe, 96 San-Chome, Denen-Chofu, Ohta-Ku, Tokyo

New Zealand—R. D. Neale, School of Engineering, Canterbury University College, Christchurch C 1

Pakistan—Mohamed Hussain Khalid, Electricity Department, Mardan

Sweden—Edy Velander, Box 5073, Stockholm 5

Transvaal—Francis E. Ingham, Post Box 8605, Johannesville, South Africa

General Committees

Executive

A. C. Monteith, *Chairman;* Westinghouse Electric Corp., 3 Gateway Center, Pittsburgh 30, Pa.	
W. J. Barret	Newark, N. J.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
T. M. Linville	Schenectady, N. Y.
W. B. Morton	Allentown, Pa.
C. S. Purnell	New York, N. Y.
Elgin B. Robertson	Dallas, Tex.

Board of Examiners

I. S. Coggeshall, *Chairman;* Western Union Telegraph Co., 60 Hudson St., New York 13, N. Y.	
L. F. Hickernell, *Vice-Chairman*	Hastings-on-Hudson, N. Y.
J. J. Anderson, *Secretary*	AIEE Headquarters
P. H. Adams	Newark, N. J.
A. E. Anderson	Philadelphia, Pa.
R. W. Atkinson	Bayonne, N. J.
R. H. Barclay	New York, N. Y.
Hendley Blackmon	East Pittsburgh, Pa.
G. S. Brown	Cambridge, Mass.
W. R. Bullard	New York, N. Y.
P. H. Chase	Philadelphia, Pa.
M. G. Crosby	Hicksville, N. Y.
A. S. Dana	Seymour, Conn.
E. W. Davis	Cambridge, Mass.
E. M. Deloraine	New York, N. Y.
E. D. Doyle	Philadelphia, Pa.
C. W. Franklin	New York, N. Y.
W. N. Goodwin, Jr.	New Hope, Pa.
S. B. Griscom	East Pittsburgh, Pa.
P. H. Hatch	Richmond Hill, N. Y.
R. A. Heising	Summit, N. J.
J. W. Horton	New London, Conn.
C. T. Hughes	Waterbury, Conn.
A. E. Knowlton	New York, N. Y.
G. H. Landis	Poughkeepsie, N. Y.
Henry Logan	New York, N. Y.
J. B. MacLean	New York, N. Y.
E. C. Molina	East Orange, N. J.
H. P. St. Clair	New York, N. Y.
E. V. Sayles	Jackson, Mich.
F. J. Scudder	Manhasset, N. Y.
H. W. Tenney	Jersey City, N. J.
Gordon Thompson	New York, N. Y.
Robert Treat	Schenectady, N. Y.
H. M. Trueblood	Dobbs Ferry, N. Y.
B. Van Ness, Jr.	Baltimore, Md.
R. G. Warner	New Haven, Conn.
S. S. Watkins	New York, N. Y.
Ernst Weber	Brooklyn, N. Y.
C. H. Willis	Princeton, N. J.
E. P. Yerkes	Philadelphia, Pa.

Charles LeGeyt Fortescue Fellowship

D. S. Bridgman	New York, N. Y.
Carl Volz, *Secretary*	State College, Pa.
E. A. Walker, *Chairman*	State College, Pa.
	(Terms expire July 31, 1955)
E. T. B. Gross	Arlington Heights, Ill.
G. E. Moore	East Pittsburgh, Pa.
	(Terms expire July 31, 1956)
N. B. Ames	Washington, D. C.
J. H. Lampe	Raleigh, N. C.
	(Terms expire July 31, 1957)

Code of Principles of Professional Conduct

P. L. Alger, *Chairman;* 1758 Wendell Ave., Schenectady, N. Y.

R. E. Argersinger, *Vice-Chairman*	Boston, Mass.
L. G. Gitzendanner, *Secretary*	Schenectady, N. Y.
M. S. Coover	Ames, Iowa
W. C. DuVall	Boulder, Colo.
G. D. Edwards	New York, N. Y.
A. H. Kidder	Philadelphia, Pa.
W. J. Morrill	Fort Wayne, Ind.
E. W. Seeger	Milwaukee, Wis.

Constitution and Bylaws

D. D. Ewing, *Chairman;* Purdue University, Lafayette, Ind.

F. S. Black	New York, N. Y.
J. Harold Karr	Springfield, Ohio
W. W. Lewis	Schenectady, N. Y.
W. S. Peterson	Los Angeles, Calif.

Edison Medal

Appointed by the President for term of five years

J. F. Calvert	Pittsburgh, Pa.
B. A. Case	New York, N. Y.
John Grotzinger	Akron, Ohio
	(Terms expire July 31, 1955)
A. H. Frampton	Toronto, Ontario, Canada
J. R. North	Jackson, Mich.
B. R. Teare, Jr.	Pittsburgh, Pa.
	(Terms expire July 31, 1956)
O. B. Blackwell	Plandome, N. Y.
J. F. Fairman, *Chairman*	New York, N. Y.
E. P. Yerkes	Philadelphia, Pa.
	(Terms expire July 31, 1957)
S. S. Attwood	Ann Arbor, Mich.
Charles F. Wagner	East Pittsburgh, Pa.
P. G. Wallace	Dallas, Tex.
	(Terms expire July 31, 1958)
R. Cutts, Jr., *Secretary*	Schenectady, N. Y.
J. D. Harper	Rockdale, Tex.
Elgin B. Robertson	Dallas, Tex.
	(Terms expire July 31, 1959)

Members of the Board of Directors elected by the Board for term of two years

F. R. Benedict	Boston, Mass.
D. D. Ewing	Lafayette, Ind.
D. A. Quarles	Washington, D. C.
	(Terms expire July 31, 1955)
L. F. Hickernell	Hastings-On-Hudson, N. Y.
A. C. Muir	Philadelphia, Pa.
E. W. Seeger	Milwaukee, Wis.
	(Terms expire July 31, 1956)

Education

Guy Kleis, *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

E. A. Walker, *Vice-Chairman*	State College, Pa.
E. M. Williams, *Secretary*	Pittsburgh, Pa.
A. M. Anderson	Schenectady, N. Y.
S. S. Attwood	Ann Arbor, Mich.
I. B. Baccus	East Lansing, Mich.
E. W. Boehne	Cambridge, Mass.
D. S. Bridgman	New York, N. Y.
E. M. Brohl	Flint, Mich.
J. F. Calvert	Pittsburgh, Pa.
M. S. Coover	Ames, Iowa
F. Hamburger, Jr.	Baltimore, Md.
H. E. Hartig	Minneapolis, Minn.
A. R. Hellwarth	Detroit, Mich.
R. J. W. Koopman	St. Louis, Mo.
J. H. Lampe	Raleigh, N. C.
F. C. Lindvall	Pasadena, Calif.
T. C. Lloyd	Springfield, Ohio
G. D. Lobingier	East Pittsburgh, Pa.
R. W. McFall	Schenectady, N. Y.
H. A. Peterson	Madison, Wis.
J. D. Ryder	Urbana, Ill.
W. J. Seeley	Durham, N. C.
H. H. Skilling	Stanford, Calif.
E. F. Smith	Gainesville, Fla.
E. M. Strong	Ithaca, N. Y.
B. R. Teare, Jr.	Pittsburgh, Pa.
G. F. Tracy	Toronto, Ontario, Canada
S. Reid Warren, Jr.	Philadelphia, Pa.

Finance

C. S. Purnell, *Chairman;* Westinghouse Electric Corp., 40 Wall Street, New York 5, N. Y.

T. M. Linville	Schenectady, N. Y.
J. P. Neubauer	New York, N. Y.

Headquarters

L. F. Stone, *Chairman;* General Electric Co., 744 Broad St., Newark 2, N. J.

J. P. Neubauer	New York, N. Y.
J. A. Parrott	New York, N. Y.

Lamme Medal

S. B. Crary, *Chairman*	Schenectady, N. Y.
C. W. Franklin	New York, N. Y.
J. S. Moulton	San Francisco, Calif.
	(Terms expire July 31, 1955)
O. S. Hockaday	Fort Worth, Tex.
J. J. Pilliod	Scarsdale, N. Y.
E. W. Seeger	Milwaukee, Wis.
	(Terms expire July 31, 1956)
E. W. Engstrom	Princeton, N. J.
M. H. Hobbs	East Pittsburgh, Pa.
C. T. Sinclair	Pittsburgh, Pa.
	(Terms expire July 31, 1957)

Management

F. K. McCune, *Chairman;* General Electric Co., 1 River Road, Schenectady 5, N. Y.

L. R. Gaty, *Vice-Chairman*	Philadelphia, Pa.
R. Cutts, Jr., *Secretary*	Schenectady, N. Y.
E. D. Ayres	Columbus, Ohio
W. C. Bell	New Haven, Conn.
C. J. Beller	Cleveland, Ohio
Walter Brenton	Portland, Oreg.
W. H. Chase	Cleveland, Ohio
L. W. Clark	Detroit, Mich.
H. O. Hodson	Amarillo, Tex.
E. E. Johnson	Schenectady, N. Y.
H. B. Kiphuth	Pittsburgh, Pa.
S. A. Langell	Canton, Ohio
W. J. Morrill	Fort Wayne, Ind.
H. W. Oetinger	Charlotte, N. C.
J. L. Pratt	Dallas, Tex.
H. H. Race	Schenectady, N. Y.
H. B. Robinson	Raleigh, N. C.
W. J. Seeley	Durham, N. C.
G. W. Spaulding	Baltimore, Md.
J. M. Wallace	Newark, N. J.
Earle Wild	Chicago, Ill.

Members-for-Life

C. L. Dawes, *Chairman;* Harvard University, Cambridge 38, Mass.

W. C. White, *Vice-Chairman*	Boston, Mass.
D. D. Ewing	Lafayette, Ind.
H. N. Muller, Jr	East Pittsburgh, Pa.
J. J. Pilliod	Scarsdale, N. Y.
C. A. Powel	Boston, Mass.
F. C. Weiss	Birmingham, Ala.

Membership

W. E. Scholz, *Chairman;* Philadelphia Electric Co., 900 Sansom St., Philadelphia, Pa.

H. R. Heckendorn, *Vice-Chairman*	Chicago, Ill.
S. S. Attwood	Ann Arbor, Mich.
Charles Clos	New York, N. Y.
E. R. Coulbourn	Birmingham, Ala.
G. W. Cross	New York, N. Y.
W. A. Dynes	Dayton, Ohio
R. K. Fairley	Schenectady, N. Y.
H. B. Hodgins	Salt Lake City, Utah
T. M. Keiller	Houston, Tex.
E. W. Morris	Los Angeles, Calif.
A. C. Muir	Philadelphia, Pa.
O. P. Settles	Denver, Colo.
M. C. Thurling	Toronto, Ontario, Canada
District Vice-Chairmen	
1 E. F. Hansen	Lynn, Mass.
2 L. B. Sponholtz	Washington, D. C.
3 V. Antofilli	New York, N. Y.
4 C. R. Vail	Durham, N. C.
5 C. C. Doerrie	Des Moines, Iowa
6 R. W. Shaw	Omaha, Nebr.
7 T. W. Landrum	Shreveport, La.
8 W. F. Poynter	San Francisco, Calif.
9 C. R. Kingsbury	Seattle, Wash.
10 C. R. Vrooman	Hamilton, Ontario, Canada

Planning and Co-ordination

L. F. Hickernell, *Chairman;* Anaconda Wire and Cable Co., Hastings-on-Hudson 6, N. Y.

N. S. Hibshman, *Secretary*	AIEE Headquarters
W. J. Barrett	Newark, N. J.
Hendley Blackmon	East Pittsburgh, Pa.
J. L. Callahan	New York, N. Y.
Bradley Cozzens	Los Angeles, Calif.
R. F. Danner	Oklahoma City, Okla.
J. H. Foote	Jackson, Mich.
A. H. Frampton	Toronto, Ontario, Canada
L. R. Gaty	Philadelphia, Pa.
E. I. Green	Murray Hill, N. J.
W. Scott Hill	Schenectady, N. Y.
M. D. Hooven	Newark, N. J.
R. E. Kistler	Seattle, Wash.
W. A. Lewis	Chicago, Ill.
F. K. McCune	Schenectady, N. Y.
C. S. Purnell	New York, N. Y.
H. L. Rusch	Princeton, N. J.
F. V. Smith	Chicago, Ill.
J. C. Strasbourger	Cleveland, Ohio
J. D. Tebo	New York, N. Y.

Prize Awards

W. R. Brownlee, *Chairman;* Southern Services, Inc., Birmingham, Ala.

E. C. Day, *Secretary*	AIEE Headquarters
W. L. Berry	Culver City, Calif.
R. M. Bozorth	Murray Hill, N. J.
C. E. Dean	Little Neck, N. Y.
E. I. Green	Murray Hill, N. J.
W. R. Harris	East Pittsburgh, Pa.
C. T. Hatcher	New York, N. Y.
W. E. Jacobsen	Schenectady, N. Y.
R. W. Jones	Evanston, Ill.
L. F. Kennedy	Schenectady, N. Y.
R. J. Krieger	Henderson, Nev.
A. J. Krupy	Chicago, Ill.
R. L. Oetting	Cleveland, Ohio
J. G. Reid	Alexandria, Va.
G. T. Royden	New York, N. Y.
G. W. Scott, Jr.	Lancaster, Pa.
C. F. Wagner	East Pittsburgh, Pa.
E. F. Watson	New York, N. Y.
E. V. Weir	Butler, Pa.

Publication

M. D. Hooven, *Chairman;* Public Service Elec. and Gas Co., 80 Park Place, Newark 1, N. J.

C. S. Rich, *Secretary*	New York, N. Y.
F. R. Benedict	Boston, Mass.
E. W. Boehne	Cambridge, Mass.
J. G. Brainerd	Philadelphia, Pa.
D. T. Braymer	New York, N. Y.
J. L. Callahan	New York, N. Y.
H. W. Codding	Newark, N. J.
C. E. Dean	Little Neck, N. Y.
W. F. Denkhaus	Philadelphia, Pa.
E. T. B. Gross	Arlington Heights, Ill.
M. F. Kent	New York, N. Y.
R. E. Kistler	Seattle, Wash.
M. G. Malti	Ithaca, N. Y.
G. R. Mezger	Clifton, N. J.
H. N. Muller, Jr.	East Pittsburgh, Pa.
Victor Siegfried	Worcester, Mass.
J. D. Tebo	New York, N. Y.

Public Relations

R. T. Ferris, *Chairman;* Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa.

M. C. Albrittain	Baltimore, Md.
V. B. Baker	Pittsburgh, Pa.
G. W. Bower	Newark, N. J.
R. K. Honaman	New York, N. Y.
M. D. Hooven	Newark, N. J.
J. T. Kimball	Phoenix, Ariz.
M. R. King	New York, N. Y.
A. E. Knowlton	New York, N. Y.
T. M. Linville	Schenectady, N. Y.
R. L. Oetting	Cleveland, Ohio
L. J. Roberts	Amarillo, Tex.
H. L. Rusch	Princeton, N. J.
W. B. Stephenson	Oklahoma City, Okla.
M. L. Stoughton	Philadelphia, Pa.
J. S. Thompson	San Francisco, Calif.

Registration of Engineers

Russell G. Warner, *Chairman;* United Illuminating Co., 80 Temple St., New Haven, Conn.

V. B. Baker	Pittsburgh, Pa.
H. A. Carlberg	Richland, Wash.
R. F. Danner	Oklahoma City, Okla.
J. H. Foote	Jackson, Mich.
N. L. Freeman	Albany, N. Y.
Ward Harrison	Cleveland, Ohio
A. H. Kidder	Philadelphia, Pa.
J. G. Kirwan	Portland, Oreg.
C. F. Moulton	Omaha, Nebr.
L. M. Robertson	Denver, Colo.
E. W. Seeger	Milwaukee, Wis.
R. V. Shepherd	Schenectady, N. Y.
R. W. Sorensen	Pasadena, Calif.

D. K. Steidinger	Washington, D. C.
E. R. Whitehead	Chicago, Ill.

Research

J. A. Hutcheson, *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

B. G. Ballard	Ottawa, Ontario, Canada
R. D. Bennett	Silver Spring, Md.
P. L. Betz	Baltimore, Md.
E. W. Boehne	Cambridge, Mass.
Cledo Burnetti	Minneapolis, Minn.
C. R. Burrows	Ithaca, N. Y.
W. G. Dow	Ann Arbor, Mich.
W. C. DuVall	Boulder, Colo.
H. E. Edgerton	Cambridge, Mass.
G. B. Hoadley	Raleigh, N. C.
J. E. Hobson	Stanford, Calif.
T. J. Killian	Durham, N. C.
I. F. Kinnard	West Lynn, Mass.
E. S. Lammers, Jr.	Atlanta, Ga.
R. W. Larson	Schenectady, N. Y.
W. A. Lewis, Jr.	Chicago, Ill.
R. C. Machler	Philadelphia, Pa.
W. G. Meese	Detroit, Mich.
R. M. Pfalzgraff	Philadelphia, Pa.
W. H. Pickering	Pasadena, Calif.
D. Ramadanoff	Cleveland, Ohio
G. B. Tebo	Toronto, Ontario, Canada

Safety

Charles E. Ganther, *Chairman;* Cleveland Electric Illuminating Co., 75 Public Square, Cleveland 1, Ohio

H. B. Whitaker, *Vice-Chairman*	Chicago, Ill.
H. H. Watson, *Secretary*	Bridgeport, Conn.
Robin Beach	Brooklyn, N. Y.
Hendley Blackmon	East Pittsburgh, Pa.
M. M. Brandon	New York, N. Y.
W. B. Buchanan	Toronto, Ontario, Canada
E. E. Carlton	Los Angeles, Calif.
T. H. Cline	Newark, Ohio
R. Cutts, Jr.	Schenectady, N. Y.
C. F. Dalziel	Berkeley, Calif.
W. P. Dobson	Toronto, Ontario, Canada
G. W. Elg	New York, N. Y.
J. H. Foote	Jackson, Mich.
J. A. Gienger	Rochester, N. Y.
F. L. Goss	Los Angeles, Calif.
R. H. Herman	Lima, Ohio
A. W. Howard	Fort Wayne, Ind.
L. S. Inskip	Murray Hill, N. J.
W. B. Kouwenhoven	Baltimore, Md.
J. O. Leslie	Reading, Pa.
R. L. Lloyd	Washington, D. C.
W. W. Loucks	Toronto, Ontario, Canada
T. M. C. Martin	Portland, Oreg.
G. Moes	Toronto, Ontario, Canada
E. W. Randall	Wilmington, Del.
W. T. Rogers	New York, N. Y.
E. C. Starr	Corvallis, Oreg.
H. E. Vann	New York, N. Y.
H. B. Williams	New York, N. Y.

Division Liaison Representatives

Communication:	
H. I. Romnes	New York, N. Y.
General Applications:	
H. F. Brown	New Haven, Conn.
Industry:	
C. N. Clark	Pittsburgh, Pa.
Power:	
E. F. Weaver	Hazelton, Pa.
Science and Electronics:	
J. T. Lusignan	Mansfield, Ohio

Medical Consultants

Dr. Cecil K. Drinker, P. O. Box 502, Falmouth, Mass.

Dr. Archer Gordon, University of Illinois, Dept. of Clinical Science, Chicago, Ill.

Dr. S. A. Talbott, Johns Hopkins Hospital, 601 North Broadway, Baltimore 5, Md.

Dr. B. L. Vosburgh, General Electric Co., 1 River Road, Schenectady 5, N. Y.

Sections

W. R. Hough, *Chairman;* Reliance Electric and Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio

Dixon Lewis, *Vice-Chairman* (*East*)	Pittsburgh, Pa.
Bradley Cozzens, *Vice-Chairman* (*West*)	Los Angeles, Calif.
J. L. Fuller, *Secretary*	Cleveland, Ohio
F. S. Bacon, Jr.	Winchester, Mass.
T. C. D. Churchill	Toronto, Ontario, Canada
Walter Criley	Nashville, Tenn.
R. B. Crow	Oak Ridge, Tenn.
M. M. de Lascurain	Mexico, D. F., Mexico
R. C. Horn	St. Louis, Mo.
V. L. Ingersoll	New York, N. Y.
A. A. Johnson	East Pittsburgh, Pa.
A. H. Keith	San Diego, Calif.
R. E. Kistler	Seattle, Wash.
R. R. O'Connor	Chicago, Ill.
F. H. Pumphrey	Gainesville, Fla.
C. S. Purnell	New York, N. Y.
Russell H. Rankin	Rochester, N. Y.
L. M. Robertson	Denver, Colo.
H. H. Sheppard	Philadelphia, Pa.
E. T. Sherwood	Milwaukee, Wis.
E. C. Starr	Corvallis, Oreg.
L. F. Stone	Newark, N. J.
J. C. Strasbourger	Cleveland, Ohio

Standards

A. C. Muir, *Chairman;* Bernwind-White Coal Mining Co., 1400 Pennsylvania Bldg., Philadelphia 2, Pa.

H. R. Huntley, *Vice-Chairman*	New York, N. Y.
J. J. Anderson, *Secretary*	AIEE Headquarters
J. W. Allen	Teterboro, N. J.
R. W. Atkinson	Bayonne, N. J.
Sterling Beckwith	Milwaukee, Wis.
P. L. Bellaschi	Portland, Oreg.
R. C. Bergvall	Pittsburgh, Pa.
M. M. Brandon	New York, N. Y.
W. R. Brownlee	Birmingham, Ala.
R. S. Burnap	Harrison, N. J.
C. L. Dawes	Cambridge, Mass.
R. D. de Kay	New York, N. Y.
W. P. Dobson	Toronto, Ontario, Canada
A. C. Fink	East Pittsburgh, Pa.
I. W. Gross	New York, N. Y.
H. E. Kent	New York, N. Y.
H. C. Koenig	New York, N. Y.
W. A. Lewis	Chicago, Ill.
G. S. Lunge	Schenectady, N. Y.
W. J. Middleton	Cambridge, Mass.
J. R. North	Jackson, Mich.
J. E. O'Brien	Washington, D. C.
E. B. Paxton	Schenectady, N. Y.
R. W. Sherwood	Beaumont, Tex.
F. B. Silsbee	Washington, D. C.
C. G. Veinott	Cleveland, Ohio

Liaison Representatives To Standards Committee

Subcommittees of Standards Committee

Name of Committee	*Representative*
Project Committee on Temperature Correlation	J. E. Clem, Chmn.
Revision of Standards Manual	M. M. Brandon, Chmn.
Sign of Reactive Power	J. J. Smith, Chmn.
Test Code for Impulse Low-Frequency and D-C Testing	J. E. Clem, Chmn.

Standards Co-ordinating Committees

Reference Values	P. L. Bellaschi, Chmn.
Insulation Testing and Coordination	F. R. Benedict, Chmn.
Basic Principles for Rating of Electric Machinery and Apparatus	W. R. Hough, Chmn.
Interference, Sound and Vibration Problems	R. S. Tucker, Chmn.
Insulation Coordination	J. H. Foote, Chmn.

Appointed by AIEE Technical Committees

Air Transportation	P. Duyan, Jr.
Basic Sciences	L. J. Berberich
Carrier Current	F. B. Gunter
Chemical, Electrochemical, and Electrothermal Applications	C. R. Olson
Communication Switching Systems	A. B. Smith
Domestic and Commercial Applications	G. E. Schall, Jr.
Electric Heating	W. C. Rudd
Electronic Power Converters	H. Winograd
General Industry Applications	F. D. Snyder
Industrial Control	W. Alvarez
Industrial Power Systems	J. J. Tesoriero
Instruments and Measurements	H. C. Koenig
Insulated Conductors	M. W. Ghen
Land Transportation	R. A. Williamson
Marine Transportation	W. N. Zippler
Metallic Rectifiers	W. F. Bonner I. R. Smith
Power Generation	F. L. Lawton
Protective Devices	E. M. Hunter
Production and Application of Light	R. L. Oetting
Rotating Machinery	E. I. Pollard
Switchgear	J. D. Wood
Telegraph Systems	R. B. Shanck
Television and Aural Broadcasting Systems	J. P. Epperson
Transformer	J. R. Meador
Transmission and Distribution	T. J. Brosnan
Wire Communications Systems	H. R. Huntley

Appointed by Standards Committee

—To ASA Sectional Committees

Project Number	*Name of Committee*	*Representatives*
A 11	Industrial Lighting	I. A. Yost
A 13	Identification of Piping Systems	H. R. Harris
A 17	Safety Code for Elevators	G. H. Reppert
A 23	School Lighting	R. C. Putnam E. M. Strong (alt.)
A 85	Protective Lighting for Industrial Properties	D. W. Rowten
B 9	Safety Code for Mechanical Refrigeration	W. C. Goodwin
B 30	Safety Code for Cranes, Derricks and Hoists	S. Rifkin
B 32	Wire and Sheet Metal Gages	W. A. DelMar M. S. Hancock A. A. Jones (alt.)
B 46	Classification and Designation of Surface Qualities	J. F. Mullen
C 2	Electrical Safety Code	E. L. Kanouse E. R. Coulbourn (alt.) A. B. Campbell (alt.)
C 5	Protection Against Lightning	W. W. Lewis H. R. Stewart G. D. McCann
C 6	Terminal Markings for Electric Power Apparatus	C. E. Asbury R. F. Munier D. K. Frost
C 7	Bare Electrical Conductors	J. H. Foote
C 8	Insulated Wires and Cables	W. A. Del Mar W. N. Zippler L. C. Petermann
C 9	Magnet Wire	H. Halperin W. A. Miller (alt.)
C 12	Code for Electricity Meters	C. L. Dawes D. T. Canfield
C 16	Radio Standardization	H. M. Turner R. E. Poole
C 18	Dry Cells and Batteries	W. B. Kouwenhoven
C 19	Industrial Control	P. B. Harwood J. A. Cortelli (alt.) K. W. John
C 29	Insulators for Electric Power Lines	W. W. Lewis J. R. North H. W. Hapgood C. F. Wagner
C 34	Mercury-Arc Rectifiers	L. W. Morton C. H. Willis
C 35	Rotating Electric Machinery on Railway Locomotives and Rail Cars and Trolley Gasoline-Electric and Oil-Electric Coaches	K. H. Gordon L. L. Johnson E. A. Foster D. M. Petty
C 37	Power Switchgear	L. R. Gaty H. V. Nye F. A. Lane R. C. Van Sickle G. S. Lunge C. A. Woodrow (alt.)
C 39	Electrical Measuring Instruments	R. Feldt H. Koenig
C 40	Storage Batteries	H. N. Stover
C 42	Definitions of Electrical Terms	E. I. Green E. B. Paxton J. E. Clem F. B. Silsbee C. L. Dawes C. F. Wagner G. H. Garcelon
C 50	Rotating Electric Machinery	R. Rudenberg T. H. Morgan P. L. Alger V. E. Schlossberg J. DeKiep J. G. Noest (alt.) C. L. Killgore E. I. Pollard (alt.)
C 52	Electric Welding	E. M. Callender F. Schnure J. F. Deffenbaugh
C 55	Capacitors	M. E. Scoville
C 57	Transformers	D. L. Levine F. J. Vogel J. L. Cantwell D. L. Curtner (alt.) J. E. Clem H. M. Jalonack (alt.) D. M. MacGregor
C 59	Electrical Insulating Materials	R. W. Atkinson E. N. Mathes W. B. Kouwenhoven
C 60	Electron Tubes	J. B. Russell S B. Ingram (alt.) A. J. Williams, Jr.
C 61	Electric and Magnetic Magnitudes and Units	R. Rudenberg J. B. Russell R. C. Machler J. J. Smith
C 62	Lightning Arresters	H. R. Stewart G. K. Ditlow appointments to be made
C 63	Radio Electrical Co-ordination	appointments to be made
C 64	Carbon, Graphite and Metal Graphite Brushes	M. S. Coover H. F. Brown appoinments to be made
C 67	Voltages Below 100	A. M. DeBellis L. S. Inskip (alt.)

C 68	Measurement of Voltage in Dielectric Tests	J. T. Lusignan R. W. Sorensen W. W. Lewis M. Newman
C 69	Electric Fences	C. F. Dalziel
C 70	Domestic Flatirons	appointments to be made
C 71	Household Electric Ranges	appointments to be made
C 72	Electric Water Heaters	J. E. Hobson
C 73	Attachment Plugs and Receptacles	S. Beckwith C. F. Scott (alt.)
C 76	Apparatus Bushings	appointments to be made
C 83	Electronic Components	J. G. Reid
C 85	Terminology for Automatic Control	appointments to be made
J 6	Rubber Protective Equipment for Electrical Workers	J. J. Pokorny
M 2	Safety Rules for Installing and Using Electrical Equipment In Coal Mines	A. C. Muir J. Z. Linsenmeyer (alt.)
M 24	Safety Rules for Installing and Using Electrical Equipment in Metal Mines	A. B. Chafetz C. O. Wood C. L. Gust
M 28	Safety Code in Quarry Operation	L. V. Winchester
O 5	Wood Poles	L. R. Gamble E. D. Ayres
Y 1	Abbreviations	H. P. Westman
Y 10	Letter Symbols	H. M. Turner H. P. Westman
Y 14	Drawings and Drafting Room Practice	F. P. Kuhl
Y 15	Preferred Practice for the Presentation of Graphs, Charts and Other Technical Illustrations	G. C. Baxter Rowe
Y 32	Graphical Symbols and Designations	G. S. Lunge M. D. Ross (alt.) L. E. Markle
Z 5	Ventilation Code	E. E. Ashley
Z 17	Preferred Numbers	H. P. Westman
Z 24	Acoustics, Vibration and Mechanical Shock	E. D. Cook C. R. Hanna R. S. Tucker R. F. Bailey (alt.) F. VonVoigtlander H. M. Turner (alt.)
Z 48	Marking of Compressed Gas Cylinders to Identify Content	H. R. Harris
Z 49	Safety in Electric and Gas Welding and Cutting	J. H. Lampe A. M. Unger (alt.)
Z 54	Safety Code for the Industrial Use of X-Rays	J. T. Wilson
Z 57	Sound Recording	L. C. Holmes

—To Joint Committees

AIEE-NEMA-EEI Joint Committee on Insulation Coordination
J. H. Foote, Chmn. AIEE Delegation

AIEE-IRE Committee on Noise Definitions
R. S. Tucker Chairman

AIEE-ASME Committee on a Recommended Specification for Prime Mover Speed Governing
M. J. Steinberg Chairman

ASME-AIEE Joint Committee on Steam Turbine Generators
F. V. Smith Chairman

AIEE-NEMA Committee on Textile Mill Control Enclosures
Swaffield O. Cowan, Chmn. AIEE Delegation

—To Other Standardizing Committees

American Research Committee on Grounding
C. T. Sinclair

Copper and Copper Alloyed Wires for Electrical Conductors (ASTM B-1)
L. E. Fogg C. T. Sinclair

Electrical Section, National Fire Protection Association
Robin Beach W. B. Kouwenhoven

Industry Committee on Interior Wiring Design
M. M. Brandon L. C. Petermann

U.S. Committee for Study Group XIV of the CCIR (International designations of frequency bands)
G. B. Ransom

ISO Technical Committee 37—Terminology
C. L. Dawes

U. S. National Committee, IEC
R. C. Sogge, President

Canadian National Committee, IEC
B. G. Ballard, President

Mexican Liaison Representative
J. V. Schmill

—To Electrical Standards Board of ASA and U.S. National Committee of International Electrotechnical Commission

Representatives	*Alternates*
F. E. Harrell	R. S. Burnap
E. B. Paxton	R. D. deKay
J. J. Pilliod	I. W. Gross

Division Assignments

Communication & Electronics	*Power*
R. S. Burnap	I. W. Gross
R. D. deKay	F. E. Harrell
J. J. Pilliod	E. B. Paxton

—To ASA Graphic Standards Board
H. P. Westman

—To ASA Mining Standards Board
A. C. Muir L. H. James (alt.)

Student Branches

R. F. Danner, *Chairman;* Oklahoma Gas and Electric Co., P. O. Box 1498, Oklahoma City 1, Okla.

W. Scott Hill, *Vice-Chairman*	Schenectady, N. Y
L. L. Nonemaker, *Secretary*	Allentown, Pa.
G. W. Bower	Newark, N. J.
J. L. Callahan	New York, N. Y.
Walter Criley	Nashville, Tenn.
C. F. Dalziel	Berkeley, Calif.
R. A. Deller	New York, N. Y.
D. D. Ewing	Lafayette, Ind.
K. A. Fegley	Philadelphia, Pa.
Wendell Fowler	Fort Worth, Tex.
R. C. Gorham	Pittsburgh, Pa.
W. F. Gray	University, Ala.
E. T. B. Gross	Arlington Heights, Ill.
G. E. Moore	East Pittsburgh, Pa.
J. W. Rittenhouse	Rolla, Mo.
J. D. Ryder	Urbana, Ill.
L. N. Stone	Corvallis, Oreg.
F. W. Tatum	Dallas, Tex.
R. T. Weil, Jr.	New York, N. Y.
E. R. Welch	Washington, D. C.

Chairmen of District Committees on Student Activities

1	M. G. Malti	Ithaca, N. Y.
2	E. C. Dubbe	Morgantown, W. Va.
3	R. E. Anderson	Newark, N. J.
4	P. H. Nelson	Gainesville, Fla.
5	E. L. Fairchild	Detroit, Mich.
6	W. A. Hixson	Rapid City, S. Dak.
7	E. L. Sitz	Manhattan, Kans.
8	R. C. Lewis	Los Angeles, Calif.
9	L. R. Kersey	Vancouver, B. C., Canada
10	R. E. Phillips	Edmonton, Alta., Canada

Technical Operations

J. D. Tebo, *Chairman;* Bell Telephone Laboratories, Inc., 463 West St., New York 14, N. Y.

W. R. Clark, *Vice-Chairman*	Philadelphia, Pa.
Hendley Blackmon, *Secretary*	East Pittsburgh, Pa.
E. C. Day, *Assistant Secretary*	Technical Papers and Programs, AIEE Headquarters
R. S. Gardner, *Assistant Secretary*	Technical Committee Activities, AIEE Headquarters
H. A. Affel	Murray Hill, N. J.
L. W. Birch	Mansfield, Ohio
W. R. Brownlee	Birmingham, Ala.
J. B. Coleman	Camden, N. J.
C. E. Ganther	Cleveland, Ohio
E. I. Green	Murray Hill, N. J.
G. W. Heumann	Schenectady, N. Y.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
M. D. Hooven	Newark, N. J.
J. A. Hutcheson	East Pittsburgh, Pa.
Guy Kleis	East Pittsburgh, Pa.
E. U. Lassen	Milwaukee, Wis.
L. J. Linde	Hyde Park, Mass.
F. K. McCune	Schenectady, N. Y.
A. C. Muir	Philadelphia, Pa.
B. G. A. Skrotzki	New York, N. Y.
R. C. Sogge	Schenectady, N. Y.
S. Reid Warren, Jr.	Philadelphia, Pa.

Transfers

E. P. Yerkes, *Chairman;* Bell Telephone Company of Pennsylvania, 1401 Arch St., Philadelphia 2, Pa.

R. R. Longwell, *Secretary*	Baltimore, Md.
R. H. Baxter	St. Louis, Mo.
C. T. Brasfield, Jr.	Birmingham, Ala.
Charles Clos	New York, N. Y.
C. Concordia	Schenectady, N. Y.
M. M. Ewell	Portland, Oreg.
A. H. Frampton	Toronto, Ontario, Canada
R. A. Hopkins	Pasadena, Calif.
K. J. Knudsen	Naugatuck, Conn.
A. J. Krupy	Chicago, Ill.
H. L. Meyer	York, Nebr.
C. T. Pearce	Philadelphia, Pa.
E. W. Seeger	Milwaukee, Wis.
A. B. Weaver	Corpus Christi, Tex.

Volta Scholarship Trustees

H. S. Osborne, *Chairman*	Upper Montclair, N. J. (*Term expires July 31, 1955*)
D. D. Ewing	Lafayette, Ind. (*Term expires July 31, 1957*)
C. A. Powel	Boston, Mass. (*Term expires July 31, 1959*)

Technical Committees

Communication Division

Communication Division Committee

H. A. Affel, *Chairman;* Bell Telephone Laboratories Inc., Murray Hill, N. J.

I. S. Coggeshall, *Vice-Chairman*	New York, N. Y.
John Meszar, *Secretary*	New York, N. Y.
L. G. Abraham	New York, N. Y.
E. D. Becken	New York, N. Y.
F. B. Bramhall	New York, N. Y.
E. C. Chamberlin, Jr.	New York, N. Y.
D. I. Cone (*Representing Board of Directors*)	San Francisco, Calif.
C. E. Dean	Little Neck, N. Y.
J. B. Epperson	Cleveland, Ohio
A. E. Frost	New York, N. Y.
H. R. Huntley	New York, N. Y.
H. I. Romnes	New York, N. Y.
E. F. Watson	New York, N. Y.

Committee on Communication Switching Systems

A. E. Frost, *Chairman;* Western Union Telegraph Co., 60 Hudson Street, New York 13, N. Y.

William Keister, *Vice-Chairman*	New York, N. Y.
Eric Brooke, *Secretary*	Galion, Ohio
C. W. Anderson	Providence, R. I.
P. E. Bowen	New York, N. Y.
C. A. Brown	Los Angeles, Calif.
R. C. Davis	New York, N. Y.
A. N. Hanson	Chicago, Ill.
A. A. James	New Haven, Conn.
E. S. Kelsey	Montreal, Que., Canada
W. T. Larner	Chicago, Ill.
H. G. Mathewson	Dallas, Texas
H. F. May	New York, N. Y.
L. T. Meeds	Washington, D. C.
John Meszar	New York, N. Y.
C. C. Minx	St. Louis, Mo.
R. J. Mitchell	Vancouver, B. C., Canada
R. S. Neikirk	Whippany, N. J.
F. H. Nolke	Washington, D. C.
C. H. Phillips	Nashville, Tenn.
A. B. Smith	Chicago, Ill.
D. L. Solomon	Alexandria, Va.
F. W. Tatum	Dallas, Texas
C. M. Tomlinson	Philadelphia, Pa.
K. E. White	Endicott, N. Y.
G. R. Zilliax	Vancouver, B. C., Canada

(No Subcommittee)

Committee on Radio Communications Systems

E. D. Becken, *Chairman;* RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

R. D. Campbell, *Vice-Chairman*	New York, N. Y.
David Talley, *Secretary*	Clifton, N. J.
J. W. Butterworth	New York, N. Y.
R. S. Caruthers	San Carlos, Calif.
A. G. Clavier	Nutley, N. J.
B. A. Currie	Los Angeles, Calif.
R. S. Dahlberg, Jr.	Philadelphia, Pa.
A. C. Dickieson	Murray Hill, N. J.
G. E. Dodrill	Washington, D. C.
K. E. Dueker	Los Angeles, Calif.
T. R. Ferry	San Francisco, Calif.
L. L. Gaddis	Kansas City, Mo.
H. R. Heckendorn	Chicago, Ill.
H. B. Hoff	Cleveland, Ohio
C. T. Koerner	Los Angeles, Calif.
C. R. Kraus	Philadelphia, Pa.
H. C. Likel	New York, N. Y.
A. A. MacDonald	Chicago, Ill.
D. J. McDonald	Montreal, Que., Canada
Roger McSweeny	New York, N. Y.
Victor Nexon	New York, N. Y.
J. E. Reid	Toronto, Ont., Canada
Hubert Sharp	Denver, Colo.
P. T. Sproul	Murray Hill, N. J.
J. M. Street, Jr.	Birmingham, Ala.
H. M. Swarm	Seattle, Wash.
N. B. Tharp	Baltimore, Md.
J. M. Walsh	New York, N. Y.
C. A. Wells	Los Angeles, Calif.
J. B. Williams	Philadelphia, Pa.
J. O. Wood	Boston, Mass.

W. J. Wortman	Charlotte, N. C.
D. L. Wylie	Chicago, Ill.
C. C. Yates	St. Louis, Mo.
W. M. Young	Washington, D. C.

(No Subcommittee)

Committee on Special Communications Applications

E. C. Chamberlin, Jr., *Chairman;* Western Union Telegraph Co., 60 Hudson Street, New York 13, N. Y.

A. A. James, *Vice-Chairman*	New Haven, Conn.
H. M. Case, *Secretary*	New York, N. Y.
G. W. Baughman	Pittsburgh, Pa.
J. B. Coleman	Camden, N. J.
W. R. Donsbach	Baltimore, Md.
N. H. Saunders	Chicago, Ill.
J. E. Spencer	Birmingham, Ala.
T. W. Stringfield	Portland, Oreg.

(No Subcommittee)

Committee on Telegraph Systems

E. F. Watson, *Chairman;* Bell Telephone Laboratories, Inc., 463 West Street, New York 14, N. Y.

F. H. Cusack, *Vice-Chairman*	New York, N. Y.
R. B. Shanck, *Secretary*	New York, N. Y.
A. S. Benjamin	Chicago, Ill.
W. H. Bliss	Princeton, N. J.
A. G. Cooley	New York, N. Y.
A. H. Gardiner	Montreal, Que., Canada
D. F. Hazen, Jr.	Philadelphia, Pa.
J. V. L. Hogan	New York, N. Y.
Alfred Kahn	New York, N. Y.
J. B. Moore	New York, N. Y.
Eldon Nichols	New York, N. Y.
H. A. Palm, Jr.	Chicago, Ill.
R. B. Steele	Toronto, Ont., Canada
V. N. Vaughan	New York, N. Y.
H. P. Westman, Sr.	New York, N. Y.
W. H. Worsham	Los Angeles, Calif.
G. B. Worthen	New York, N. Y.

Facsimile Subcommittee

A. G. Cooley, *Chairman;* Times Facsimile Corporation, 540 West 58th Street, New York 19, N. Y.

W. H. Bliss	Princeton, N. J.
F. H. Cusack	New York, N. Y.
J. V. L. Hogan	New York, N. Y.

Committee on Television and Aural Broadcasting Systems

J. B. Epperson, *Chairman;* Scripps-Howard Radio, Inc., 1816 East 13th Street, Cleveland 14, Ohio

C. M. Braum, *Vice-Chairman*	Washington, D. C.
R. K. Hellmann, *Secretary*	Little Neck, N. Y.
E. D. Barcus	Los Angeles, Calif.
G. H. Brown	Princeton, N. J.
J. F. Cannon	New Haven, Conn.
J. B. Coleman	Camden, N. J.
J. F. Craib	Mineola, N. Y.
C. E. Dean	Little Neck, N. Y.
W. L. Everitt	Urbana, Ill.
P. C. Goldmark	New York, N. Y.
C. F. Hanson	Los Angeles, Calif.
R. N. Harmon	Washington, D. C.
D. E. Harnett	Syracuse, N. Y.
Scott Helt	Clifton, N. J.
H. F. Herbig	Nutley, N. J.
C. R. Kraus	Philadelphia, Pa.
G. C. Larson	Metuchen, N. J.
Carmine Masucci	Long Island City, N. Y.
True McLean	Ithaca, N. Y.
W. A. Nichols	Montreal, Que., Canada
L. E. Rawls	Nashville, Tenn.
O. W. B. Reed, Jr.	Washington, D. C.
J. W. Rieke	Murray Hill, N. J.
F. B. Roberts	New York, N. Y.
L. M. Rodgers	Philadelphia, Pa.
R. E. Shelby	New York, N. Y.
Carl E. Smith	Cleveland, Ohio
G. R. Town	Ames, Iowa
V. E. Trouant	Camden, N. J.
A. P. Walker	Washington, D. C.
H. E. Weppler	New York, N. Y.
H. O. Wood	Philadelphia, Pa.

(No Subcommittee)

Committee on Wire Communications Systems

H. R. Huntley, *Chairman;* American Telephone & Telegraph Co., 195 Broadway, New York, 7, N. Y.

L. R. Montfort, *Vice-Chairman*	New York, N. Y.
D. T. Osgood, *Secretary*	New York, N. Y.
A. L. Albert	Corvallis, Oreg.
W. M. Allen	Portland, Oreg.
C. A. Armstrong	New York, N. Y.
D. H. Baker	Detroit, Mich.
R. L. Brinton	San Francisco, Calif.
W. C. Burnett	Charlotte, N. C.
G. E. Burridge	Toronto, Ont., Canada
E. M. Calderword	San Francisco, Calif.
W. L. Carter	San Francisco, Calif.
R. S. Caruthers	San Carlos, Calif.
G. E. Dodrill	Washington, D. C.
P. G. Edwards	Murray Hill, N. J.
I. M. Ellestad	Omaha, Nebr.
T. J. Fleming	Santa Monica, Calif.
D. G. Geiger	Toronto, Ont., Canada
R. F. Gosnell	St. Louis, Mo.
W. C. Hankison	Amarillo, Texas
C. D. Howe	Seattle, Wash.
L. H. Hutchins, Jr.	Newington, N. H.
J. R. Hyneman	New York, N. Y.
E. A. Johnson	New Haven, Conn.
E. R. Jones	Denver, Colo.
C. H. McGuire	Montreal, Que., Canada
R. H. Miller	San Francisco, Calif.
F. B. Morgan	Madison, Wis.
Elmer Niemoller	Los Angeles, Calif.
W. E. Noller	Berkeley, Calif.
R. R. O'Connor	Chicago, Ill.
W. F. Potter	Boston, Mass.
D. A. Riechel	Portland, Oreg.
A. L. Rumsey	Albany, N. Y.
L. J. Shaffer	Cleveland, Ohio
W. T. Smith	Washington, D. C.
L. C. Starbird	Dallas, Texas

(No Subcommittee)

General Applications Division

General Applications Division Committee

L. W. Birch, *Chairman;* Ohio Brass Company, Transportation Department, Mansfield, Ohio

R. L. Oetting, *Vice-Chairman*	Cleveland, Ohio
A. G. Oehler, *Secretary*	New York, N. Y.
W. L. Berry	Culver City, Calif.
H. F. Brown	New York, N. Y.
P. H. Hatch	Richmond Hill, N. Y.
W. E. Jacobsen	Schenectady, N. Y.
T. C. Johnson	Bloomfield, N. J.
E. W. Seeger *(Representing Board of Directors)*	Milwaukee, Wis.
S. D. Summers	Washington, D. C.

Committee on Air Transportation

W. L. Berry, *Chairman;* Hughes Tool Co., Aircraft Division, Florence & Teale Streets, Culver City, Calif.

L. R. Larson, *Vice-Chairman*	Washington, D. C.
Peter Duyan, Jr., *Secretary*	Santa Monica, Calif.
J. W. Allen	Teterboro, N. J.
B. O. Austin	Lima, Ohio
E. P. Barlow	Baltimore, Md.
W. V. Boughton	Arcadia, Calif.
W. C. Bryant	Burbank, Calif.
H. E. Crabtree	Lynn, Mass.
J. P. Dallas	Culver City, Calif.
D. W. Exner	Seattle, Wash.
H. J. Finison	Boston, Mass.
Fred Foulon	El Segundo, Calif.
D. E. Fritz	Cleveland, Ohio
Elio Fueyo	Miami, Fla.
C. E. Gagnier	Torrance, Calif.
S. H. Hanville, Jr.	Cleveland, Ohio
W. T. Harding	Dayton, Ohio
T. B. Holliday	Elmhurst, Ill.
R. D. Jones	Fort Wayne, Ind.
E. F. Kotnik	San Diego, Calif.
F. L. Lyons	Torrance, Calif.
John Maxian, Jr.	Los Angeles, Calif.
J. D. Miner	Lima, Ohio
R. L. Olson	St. Paul, Minn.
G. A. Phillips	Schenectady, N. Y.
Felix Quirino	Fort Worth, Texas
J. F. Randack, Jr.	Dayton, Ohio
V. O. Ray	Lima, Ohio
H. F. Rempt	Burbank, Calif.
R. A. Rugge	Minneapolis, Minn.
D. H. Scott	Washington, D. C.
K. R. Smythe	Johnsville, Pa.
H. R. Tragesser	Cleveland, Ohio
A. F. Trumbull	San Francisco, Calif.
F. H. Walker	Buffalo, N. Y.
O. C. Walley	Cleveland, Ohio
W. W. West	New York, N. Y.

Subcommittee on Aircraft Electrical Systems

D. W. Exner, *Chairman;* Boeing Airplane Company, Seattle, Wash.

K. W. Carlson	Schenectady, N. Y.
L. M. Cobb	Johnsville, Pa.
R. R. Jenner	Wichita, Kans.
E. F. Kotnik	San Diego, Calif.
C. L. Mershon	Lima, Ohio
C. S. Milliken	Burbank, Calif.
R. L. Olson	St. Paul, Minn.
J. F. Randack, Jr.	Dayton, Ohio
A. F. Trumbull	San Francisco, Calif.
O. C. Walley	Cleveland, Ohio
B. J. Wilson	Washington, D. C.

Subcommittee on Electrical Control, Protective Devices, and Cable

B. O. Austin, *Chairman:* Westinghouse Electric Corp., Lima, Ohio

E. P. Barlow	Baltimore, Md.
E. C. Bottemiller	Schenectady, N. Y.
W. C. Bryant	Burbank, Calif.
S. C. Caldwell	Schenectady, N. Y.
R. A. Millermaster	Milwaukee, Wis.
A. J. Mustard	Miami, Fla.
W. G. Neild	Eatontown, N. J.
R. L. Olson	St. Paul, Minn.
Jerome Ottmar	Attleboro, Mass.
J. W. Pobst	Johnsville, Pa.
O. C. Walley	Cleveland, Ohio

Subcommittee on Aircraft Electrical Rotating Machinery

H. R. Tragesser, *Chairman;* Jack & Heintz, Inc., Cleveland, Ohio

V. C. Holloway	Washington, D. C.
R. D. Jones	Fort Wayne, Ind.
W. R. Kruesi	West Lynn, Mass.
M. H. Lowe	Washington, D. C.
T. J. Martin	Seattle, Wash.
R. R. Miille	Lima, Ohio
R. R. Smith, Jr.	Philadelphia, Pa.

Subcommittee on Rating of Airborne Electrical Apparatus

D. H. Scott, *Chairman;* Electricity Division, Naval Research Laboratory, Washington 25, D. C.

E. K. McMullin, *Vice-Chairman*	Los Angeles, Calif.
Witt Beatson	Washington, D. C.
Herman Braun	Lima, Ohio
Peter Duyan, Jr.	Santa Monica, Calif.
R. M. Fisher, Jr.	West Lynn, Mass.
P. W. Franklin	Johnsville, Pa.
R. D. Jones	Fort Wayne, Ind.
E. F. Kotnik	San Diego, Calif.
L. J. Lyons	Hawthorne, Calif.
C. G. Martin	Cleveland, Ohio
William Merrill	Burbank, Calif.
E. Naumann	Dayton, Ohio
F. M. Potter	Teterboro, N. J.
Walter Robinson	Columbus, Ohio
R. H. Simonds	Seattle, Wash.
H. B. Van Dagens	Chicago, Ill.
L. A. Zahorsky	Grand Rapids, Mich.

Subcommittee on Dielectric Testing Procedures for Aircraft Electrical Equipment and Insulation Materials

J. P. Dallas, *Chairman;* Hughes Tool Company, Aircraft Division, Culver City, Calif.

D. W. Exner	Seattle, Wash.
Fred Foulon	El Segundo, Calif.
H. S. Gillespie	Teterboro, N. J
C. S. McMeekin	Lima, Ohio
C. S. Milliken	Burbank, Calif.
W. B. Penn	West Lynn, Mass.

Committee on Domestic & Commercial Applications

T. C. Johnson, *Chairman;* General Electric Co., 5 Lawrence Street, Bloomfield, N. J.

H. F. Hoebel, *Vice-Chairman*	New York, N. Y.
J. A. Deubel, *Secretary*	Milwaukee, Wis.
Constantine Bary	Philadelphia, Pa.
J. C. Beckett	San Francisco, Calif.
O. K. Buck	Los Angeles, Calif.
T. H. Cline	Newark, Ohio
J. O. Covington	New York, N. Y.
R. W. Fauquet	Chicago, Ill.
O. W. Hurd	Prosser, Wash.
H. W. Kelley	Washington, D. C.
D. E. Krammes	North Canton, Ohio
J. B. MacDonald	Toronto, Ont., Canada
B. H. Martin	Chattanooga, Tenn.
T. L. Matney	Richland, Wash.
W. R. Milby	Detroit, Mich.
J. H. Oliver	Schenectady, N. Y.
B. F. Parr	Mansfield, Ohio
L. N. Roberson	Seattle, Wash.
G. E. Schall, Jr.	New York, N. Y.
R. G. Scott	Vancouver, B. C., Canada
G. S. Smith	Seattle, Wash.
R. E. Smith	Joliet, Ill.
W. W. Warner	Fort Wayne, Ind.
H. H. Watson	Bridgeport, Conn.
H. B. Wolf	Charlotte, N. C.
T. T. Woodson	Louisville, Ky.
R. F. Zimmerman	Dayton, Ohio

Electric Space Heating and Heat Pumps Subcommittee (West)

L. N. Roberson, *Chairman;* L. N. Roberson Co., 1539 East 103rd Street, Seattle 55, Wash.

J. C. Beckett	San Francisco, Calif.
O. K. Buck	Los Angeles, Calif.
O. W. Hurd	Prosser, Wash.
R. G. Scott	Vancouver, B. C., Canada
G. S. Smith	Seattle, Wash.

Electric Space Heating and Heat Pumps Subcommittee (East)

Constantine Bary, *Chairman;* Philadelphia Electric Co., 1000 Chestnut Street, Philadelphia 5, Pa.

S. T. Bowan	Cleveland, Ohio
J. O. Covington	New York, N. Y.
B. H. Martin	Chattanooga, Tenn.
J. B. MacDonald	Toronto, Ont., Canada
G. E. Schall, Jr.	New York, N. Y.
H. B. Wolf	Charlotte, N. C.

Domestic Appliances Subcommittee

B. F. Parr, *Chairman;* Westinghouse Electric Corp., 246 East 4th Street, Mansfield, Ohio

J. A. Deubel	Milwaukee, Wis.
W. H. Farrell	Chicago, Ill.
R. W. Fauquet	Chicago, Ill.
D. E. Krammes	North Canton, Ohio
W. R. Milby	Detroit, Mich.
T. T. Woodson	Louisville, Ky.
R. F. Zimmerman	Dayton, Ohio

Farm Electrification Subcommittee

J. H. Oliver, *Chairman;* General Electric Co., Farm Industry Division, Schenectady, N. Y.

W. B. Buchanan	Toronto, Ont., Canada
T. H. Cline	Newark, Ohio
H. W. Kelley	Washington, D. C.
W. W. Warner	Fort Wayne, Ind.
H. H. Watson	Bridgeport, Conn.

Committee on Land Transportation

P. H. Hatch, *Chairman;* Long Island Railroad Co., Morris Park Shops, 91-53 121st Street, Richmond Hill 18, N. Y.

R. L. Kimball, *Vice-Chairman*	New York, N. Y.
F. E. Spindler, *Secretary*	East Pittsburgh, Pa.
J. C. Aydelott	Erie, Pa.
R. J. Berti	Omaha, Nebr.
L. S. Billau	Baltimore, Md.
L. W. Birch	Mansfield, Ohio
H. F. Brown	New York, N. Y.
D. M. Burckett	Boston, Mass.
Hector Chaput	Ottawa, Ont., Canada
R. J. Corfield	Garfield, Utah
Andrew Costic	Hoboken, N. J.
V. F. Dowden	New Haven, Conn.
Llewellyn Evans	Chattanooga, Tenn.
E. A. Foster	Chicago, Ill.
J. C. Fox	Princeton, W. Va.
A. P. Frey	Baltimore, Md.
K. H. Gordon	Philadelphia, Pa.
C. H. Griffith	Parsons, Kans.
W. S. H. Hamilton	Larchmont, N. Y.
D. F. Haney	Montreal, Que., Canada
A. M. Harrison	East Pittsburgh, Pa.
G. L. Hoard	Seattle, Wash.
J. G. Inglis	Toronto, Ont., Canada
A. P. Jerencsik	Columbus, Ohio
L. L. Johnson	LaGrange, Ill.
C. A. Koch	Cleveland, Ohio
L. E. Legg	Chicago, Ill.
S. B. Lent	Boston, Mass.
S. W. Marras	Chicago, Ill.
T. M. C. Martin	Portland, Oreg.
P. A. McGee	New York, N. Y.
E. B. Meissner	St. Louis, Mo.
S. R. Negley	Philadelphia, Pa.
J. A. Noertker	Cincinnati, Ohio
A. G. Oehler	New York, N. Y.
G. W. Painter	Montreal, Que., Canada
J. H. Ray	Cleveland, Ohio
F. L. ReQua	San Francisco, Calif.
Dwight L. Smith	Highwood, Ill.
Jacob Stair, Jr.	Philadelphia, Pa.
D. R. Staples	Eddystone, Pa.
M. C. Swanson	Schenectady, N. Y.
J. D. Sylvester	Montreal, Que., Canada
J. T. Turner	Vancouver, B. C., Canada
R. S. Warren	Elkhart, Ind.
L. F. Williams	San Francisco, Calif.
R. A. Williamson	Erie, Pa.
H. P. Wright	Baltimore, Md.
Laurence Wylie	Seattle, Wash.

Heavy Traction Papers and Plans Subcommittee

H. F. Brown, *Chairman;* Gibbs & Hill, Inc., Pennsylvania Station, New York 1, N. Y.

J. C. Aydelott	Erie, Pa.
R. L. Kimball	New York, N. Y.
T. M. C. Martin	Portland, Oreg.
S. R. Negley	Philadelphia, Pa.
M. C. Swanson	Schenectady, N. Y.
Laurence Wylie	Seattle, Wash.

Heavy Traction Electrification Data Subcommittee

L. W. Birch, *Chairman;* Ohio Brass Company, Mansfield, Ohio

Light Traction Papers and Plans Subcommittee

A. M. Harrison, *Chairman;* Westinghouse Electric Corp., T. & G. Div. 5-N-38, East Pittsburgh, Pa.

J. C. Aydelott	Erie, Pa.
L. W. Birch	Mansfield, Ohio
A. P. Frey	Baltimore, Md.
J. G. Inglis	Toronto, Ont., Canada
R. L. Kimball	New York, N. Y.
S. B. Lent	Boston, Mass.
Dwight L. Smith	Highwood, Ill.

Diesel-Electric Traction Papers and Plans Subcommittee

A. G. Oehler, *Chairman;* Simmons-Boardman Publishing Co., 30 Church Street, New York 7, N. Y.

J. C. Aydelott	Erie, Pa.
E. A. Foster	Chicago, Ill.
D. F. Haney	Montreal, Que., Canada
L. L. Johnson	La Grange, Ill.
L. E. Legg	Chicago, Ill.
S. W. Marras	Chicago, Ill.
P. A. McGee	New York, N. Y.
S. R. Negley	Philadelphia, Pa.
G. W. Painter	Montreal, Que., Canada
M. C. Swanson	Schenectady, N. Y.
J. D. Sylvester	Montreal, Que., Canada
H. P. Wright	Baltimore, Md.

AIEE Committee #11 (A.S.A. C-35, Rotating Electrical Machinery on Railway Locomotives and Rail Cars, and Trolley, Gasoline-Electric and Oil-Electric Coaches)

K. H. Gordon, *Chairman;* Pennsylvania Railroad Co., 1635 Suburban Station Building, Philadelphia 4, Pa.

J. C. Aydelott	Erie, Pa.
A. M. Harrison	East Pittsburgh, Pa.
L. L. Johnson	La Grange, Ill.
D. M. Petty	Bethlehem, Pa.

Liaison Representative on Standards Committee

R. A. Williamson, General Electric Co., 2901 East Lake Road, Erie 1, Pa.

Subcommittee on Revision of AIEE Standard #16 (Electric Railway Control Apparatus) A.S.A. C-48

R. A. Williamson, *Chairman;* General Electric Co., 2901 East Lake Road, Erie, Pa.

J. C. Fox	Princeton, W. Va.
K. H. Gordon	Philadelphia, Pa.
M. C. Swanson	Schenectady, N. Y.

Committee on Marine Transportation

W. E. Jacobsen, *Chairman;* General Electric Co., 1 River Road, Schenectady 5, N. Y.

J. E. Jones, *Vice-Chairman*	Milwaukee, Wis.
W. N. Zippler, *Secretary*	New York, N. Y.
J. M. Apple	Washington, D. C.
P. D. DuMont	New York, N. Y.
J. B. Feder	Washington, D. C.
R. M. Franklin	Great Neck, N. Y.
R. W. Frost	Amesbury, Mass.
A. R. Gatewood	New York, N. Y.
E. A. Geary	Camden, N. J.
L. M. Goldsmith	Philadelphia, Pa.
P. A. Guise	New York, N. Y.
H. F. Harvey, Jr.	Newport News, Va.
S. A. Haverstitch	East Pittsburgh, Pa.
D. B. Hoover	East Pittsburgh, Pa.
Cornelius Krommenhock	Brooklyn, N. Y.
V. W. Mayer	Washington, D. C.
E. M. Rothen	New York, N. Y.
J. D. Shuster	Quincy, Mass.
G. O. Watson	London, England
O. A. Wilde	Chester, Pa.
Meyer Ziev	Philadelphia, Pa.

Power Generation Subcommittee

Oscar A. Wilde, *Chairman;* Sun Shipbuilding & Dry Dock Co., Chester, Pa.

John Apple	Washington, D. C.
L. M. Goldsmith	Philadelphia, Pa.
S. A. Haverstitch	East Pittsburgh, Pa.
D. B. Hoover	East Pittsburgh, Pa.
W. E. Jacobsen	Schenectady, N. Y.

Power Application Subcommittee

L. M. Goldsmith, *Chairman;* Atlantic Refining Co., 260 South Broad Street, Philadelphia, Pa.

John Apple	Washington, D. C.
J. B. Feder	Washington, D. C.
S. A. Haverstitch	East Pittsburgh, Pa.
D. B. Hoover	East Pittsburgh, Pa.
W. E. Jacobsen	Schenectady, N. Y.
J. E. Jones	Milwaukee, Wis.

Wires and Cables Subcommittee

W. N. Zippler, *Chairman;* Gibbs & Cox, Inc., 1 Broadway, New York 4, N. Y.

P. J. DuMont	New York, N. Y.
J. B. Feder	Washington, D. C.
A. R. Gatewood	New York, N. Y.
W. E. Jacobsen	Schenectady, N. Y.
V. W. Mayer	Washington, D. C.

Switchboards and Control Subcommittee

S. A. Haverstitch, *Chairman;* Westinghouse Electric Corporation, East Pittsburgh, Pa.

P. J. DuMont	New York, N. Y.
H. F. Harvey, Jr.	Newport News, Va.
J. E. Jones	Milwaukee, Wis.
Cornelius Krommenhock	Brooklyn, N. Y.
J. D. Shuster	Quincy, Mass.

Distribution Subcommittee

H. F. Harvey, Jr., *Chairman;* Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

John Apple	Washington, D. C.
J. B. Feder	Washington, D. C.
A. R. Gatewood	New York, N. Y.
E. A. Geary	Camden, N. J.
L. M. Goldsmith	Philadelphia, Pa.
P. A. Guise	New York, N. Y.
V. W. Mayer	Washington, D. C.
W. N. Zippler	New York, N. Y.

Fittings and Appliances Subcommittee

V. W. Mayer, *Chairman;* U. S. Maritime Commission, Technical Div., U. S. Dept. of Commerce Bldg., Washington 25, D. C.

P. J. DuMont	New York, N. Y.
R. W. Frost	Amesbury, Mass.
E. A. Geary	Camden, N. J.
P. A. Guise	New York, N. Y.
H. F. Harvey, Jr.	Newport News, Va.
E. M. Rothen	New York, N. Y.
J. D. Shuster	Quincy, Mass.
O. A. Wilde	Chester, Pa.

Communications and Alarms Subcommittee

R. W. Frost, *Chairman;* Henschel Corporation, 14 Cedar Street, Amesbury, Mass.

J. B. Feder	Washington, D. C.
R. M. Franklin	Great Neck, N. Y.
A. R. Gatewood	New York, N. Y.
E. A. Geary	Camden, N. J.
Cornelius Krommenhock	Brooklyn, N. Y.
E. M. Rothen	New York, N. Y.
J. D. Shuster	Quincy, Mass.

Navigation Equipment Subcommittee

R. M. Franklin, *Chairman;* Sperry Gyroscope Co., Great Neck, N. Y.

R. W. Frost	Amesbury, Mass.
P. A. Guise	New York, N. Y.
Cornelius Krommenhock	Brooklyn, N. Y.
E. M. Rothen	New York, N. Y.
Meyer Ziev	Philadelphia, Pa.

Publicity, Personnel and History Subcommittee

H. F. Harvey, Jr., *Chairman;* Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

O. A. Wilde	Chester, Pa.
W. N. Zippler	New York, N. Y.

Editing Subcommittee

W. N. Zippler, *Chairman;* Gibbs & Cox, Inc., 1 Broadway, New York 4, N. Y.

H. F. Franklin, Jr.	Newport News, Va.

International Standardization Subcommittee

A. R. Gatewood, *Chairman;* American Bureau of Shipping, 45 Broad Street, New York 4, N. Y.

J. B. Feder	Washington, D. C.
H. F. Harvey, Jr.	Newport News, Va.
S. A. Haverstitch	East Pittsburgh, Pa.
W. N. Zippler	New York, N. Y.

Committee on Production and Application of Light

R. L. Oetting, *Chairman;* General Electric Co., Nela Park, Cleveland 12, Ohio

J. F. Dickerhoff, *Vice-Chairman*	Mineola, N. Y.
J. F. Angier, *Secretary*	Washington, D. C.
B. F. Avery	Chicago, Ill.
L. E. Barbrow	Washington, D. C.
L. H. Brown	Stanford, Calif.
S. W. Bruun	New York, N. Y.
C. W. Carstens	Itasca, Ill.
H. E. Church	Des Plaines, Ill.
M. D. Clayton	Storrs, Conn.
D. M. Finch	Berkeley, Calif.
H. S. Gilmore	Chicago, Ill.
F. B. Graham	New York, N. Y.
Harry Hadsel	Chicago, Ill.
G. C. Harvey	Danville, Ill.
W. A. Hedrich	Ann Arbor, Mich.
D. L. Hemmenway	Chicago, Ill.
J. S. Lindsay	Lynn, Mass.
J. G. Mitchell	Cleveland, Ohio
Kennard Pinder	Wilmington, Del.
R. C. Putnam	Cleveland, Ohio
D. W. Rowten	Cleveland, Ohio
E. H. Salter	New York, N. Y.
T. C. Sargent	Salem, Mass.
T. H. Shepherd	Los Angeles, Calif.
D. W. Shirley, Jr.	Corvallis, Oreg.
E. M. Strong	Ithaca, N. Y.
H. F. Wall	Detroit, Mich.
M. N. Waterman	Bloomfield, N. J.
R. C. Wey	Canton, Ohio
C. C. Whipple	Brooklyn, N. Y.

(No Subcommittees)

Industry Division

Industry Division Committee

G. W. Heumann, *Chairman;* General Electric Co., Industry Control Dept., Bldg. 285-121, Schenectady 5, N. Y.

C. N. Clark, *Vice-Chairman*	Pittsburgh, Pa.
R. S. Gardner, *Secretary*	New York, N. Y.
Harold Bunte	Chicago, Ill.
H. W. Cory	Milwaukee, Wis.
F. S. Glaza	Freeport, Texas
W. R. Harris	East Pittsburgh, Pa.
E. U. Lassen	Milwaukee, Wis.
E. J. Limpel	Milwaukee, Wis.
J. Z. Linsenmeyer	Pittsburgh, Pa.
A. C. Muir (*Representing Board of Directors*)	Philadelphia, Pa.
H. L. Palmer	Schenectady, N. Y.
August Schmidt, Jr.	Schenectady, N. Y.
F. D. Snyder	New York, N. Y.
S. A. Warner	New York, N. Y.

Committee on Chemical, Electrochemical and Electrothermal Applications

F. S. Glaza, *Chairman;* Dow Chemical Co. Engineering Dept., Texas Division, Freeport, Texas

R. M. Wainwright, *Vice-Chairman*	Urbana, Ill.
C. R. Olsou, *Secretary*	East Pittsburgh, Pa.
F. V. Andreae	Chattanooga, Tenn.
F. M. Baxandall	Midland, Mich.
E. J. Borrebach	East Pittsburgh, Pa.
F. T. Bowditch	Cleveland, Ohio
E. C. Clark	Schenectady, N. Y.
C. S. Collier	Wilmington, Del.
W. C. Dreyer	Houston, Texas
J. N. Fogg	Baton Rouge, La.
R. C. Graham	Rome, N. Y.
W. E. Gutzwiller	Milwaukee, Wis.
C. S. Hague	East Pittsburgh, Pa.
E. A. Hanff	Pittsburgh, Pa.
J. D. Harper	Rockdale, Texas
N. E. Hehner	Toledo, Ohio
H. E. Houck	Wilmington, Del.
F H. Justin	Midland, Mich.
F. L. Lawton	Montreal, Que., Canada
A. E. Marshall	St. Louis, Mo.
F. J. Mollerus	Richland, Wash.
B. J. Nankervis	Freeport, Texas
Waldo Porter	Vancouver, Wash.
H. C. Riggs	Philadelphia, Pa.
F. F. Robison, Jr.	Midland, Mich.
S. J. Rosch	Hastings-on-Hudson, N. Y.
G. B. Scheer	Oakland, Calif.
E. O. Scott	Welland, Ont., Canada
O. J. Streever	Newport News, Va.
E. B. Turner	Schenectady, N. Y.
J. J. Unger	Cleveland, Ohio
H. W. Wahlquist	New York, N. Y.
G. O. Wardrop	South Charleston, W. Va.
W. B. Wilson	Schenectady, N. Y.
L. H. Wolgast	Troutdale, Oreg.
H. H. Zielinski	Schenectady, N. Y.

Storage Batteries Subcommittee

H. C. Riggs, *Chairman;* The Electric Storage Battery Co., P. O. Box 5723, Philadelphia 32, Pa.

W. J. Hamer	Washington, D. C.
J. R. Hardy	New York, N. Y.
N. E. Hehner	Owosso, Mich.
H. E. Jensen	Washington, D. C.
G. B. Schleicher	Philadelphia, Pa.
H. N. Stover	Trenton, N. J.
J. J. Unger	Cleveland, Ohio
G. W. Vinal	Westerly, R. I.
H. H. Zielinski	Schenectady, N. Y.

Electrothermal Processes Subcommittee

E. J. Borrebach, *Chairman;* Westinghouse Electric Corp., E. Pittsburgh, Pa.

E. A. Hanff, *Vice-Chairman*	Pittsburgh, Pa.
F. V. Andreae	Chattanooga, Tenn.
F. T. Bowditch	Cleveland, Ohio
D. R. Cochran	Schenectady, N. Y.
J. R. Lee	Pittsburgh, Pa.
E. O. Scott	Welland, Ont., Canada

Cathodic Protection Subcommittee

R. M. Wainwright, *Chairman;* College of Engineering, University of Illinois, Urbana, Ill.

J. P. Oliver, *Vice-Chairman*	Cleveland, Ohio
L. H. Austin	Portland, Oreg.
W. E. Coleman	Pittsburgh, Pa.
I. C. Dietze	Los Angeles, Calif.
S. R. Hart, Jr.	Birmingham, Ala.
J. C. Leffel	Detroit, Mich.
A. W. Peabody	Jackson, Miss.
L. P. Schaefer	Detroit, Mich.
W. J. Schwerdtfeger	Washington, D. C.
L. R. Smith	Ogallala, Nebr.
E. R. Stauffacher	Los Angeles, Calif.
O. J. Streever	Newport News, Va.
H. W. Wahlquist	New York, N. Y.
O. W. Zastrow	Washington, D. C.

Chemical Industry Subcommittee

J. N. Fogg, *Chairman;* Ethyl Corporation, Baton Rouge, La.

P. R. Callaham	Lake Forest, Ill.
C. S. Collier	Wilmington, Del.
W. C. Dreyer	Houston, Texas
J. W. Eberman	Pasadena, Texas
R. C. Graham	Rome, N. Y.
H. N. Hickok	Houston, Texas
H. E. Houck	Wilmington, Del.
G. B. Jamison	Houston, Texas
F. L. Kaestle	Schenectady, N. Y.
A. J. Lehman	Port Sulphur, La.
J. J. Loustaunau	Boston, Mass.
A. E. Marshall	St. Louis, Mo.
F. F. Robison, Jr.	Midland, Mich.
S. J. Rosch	Yonkers, N. Y.
R. F. Shumar	Midland, Mich.
R. W. Scott	Syracuse, N. Y.
H. R. Walker	Midland, Mich.
G. O. Wardrop	South Charleston, W. Va.
T. O. Wood	Freeport, Texas

Electrochemical Processes Subcommittee

W. E. Gutzwiller, *Chairman;* Allis-Chalmers Mfg. Co., Milwaukee, Wis.

C. S. Hague, Jr., *Secretary*	East Pittsburgh, Pa.
F. A. Anderson	Wilmington, Del.
J. R. Auld	Montreal, Que., Canada
F. M. Baxandall	Midland, Mich.
H. O. Bourque	Pasadena, Texas
F. M. Fisher	Barberton, Ohio
J. N. Fogg	Baton Rouge, La.
W. Fraser	Arvida, Que., Canada
W. C. Gardiner	Niagara Falls, N. Y.
A. D. Hadley	Portland, Oreg.
E. M. Hansford	Alloy, W. Va.
A. D. Hargroder	Lake Charles, La.
J. D. Harper	Rockdale, Texas
John Kiefer	Jones Mills, Ark.
C. A. Langlois	Corpus Christi, Texas
A. E. Marshall	St. Louis, Mo.
Ken McCaskill	Niagara Falls, N. Y.
E. M. Meyer	Carteret, N. J.
B. J. Nankervis	Freeport, Texas
Waldo Porter	Vancouver, Wash.
F. H. Rockwell	Painesville, Ohio
G. B. Scheer	Oakland, Calif.
F. D. Shaw	South Plainfield, N. J.
J. W. Tracht	Wyandotte, Mich.
R. N. Wagner	Pittsburgh, Pa.
H. H. Zielinski	Schenectady, N. Y.

Pacific Coast Subcommittee

F. J. Mollerus, *Chairman;* General Electric Company, Hanford Engineer Works, Richland, Wash.

(*Personnel to be selected*)

Committee on Electric Heating

Harold Bunte, *Chairman;* Commonwealth Edison Co., 72 West Adams Street, Chicago 90, Ill.

W. C. Rudd, *Vice-Chairman*	New Rochelle, N. Y.
R. W. Kise, *Secretary*	Schenectady, N. Y.
J. H. Ahrens	Hartford, Conn.
E. L. Bailey	Pasadena, Calif.
I. J. Barber	Fostoria, Ohio
E. J. Bates	Dayton, Ohio
B. A. Bovee	Niagara Falls, N. Y.
Mrs. B. O. Buckland	Schenectady, N. Y.
F. T. Chestnut	Trenton, N. J.
J. E. Eiselein	Camden, N. J.
J. E. Friess	Detroit, Mich.
P. H. Goodell	Detroit, Mich.
M. M. Greer	Middletown, Conn.
L. P. Hynes	Haddonfield, N. J.
T. P. Kinn	Baltimore, Md.
R. E. Kirby	Baltimore, Md.
C. F. Kreiser	Pittsburgh, Pa.
J. B. MacDonald	Toronto, Ont., Canada

A. D. Moore	Ann Arbor, Mich.
D. S. Pearson	State College, Pa.
C. E. Peck	Meadville, Pa.
E. B. Shand	Corning, N. Y.
A. D. Spillman	Philadelphia, Pa.
L. A. Strobel	Detroit, Mich.
C. A. Tudbury	Cleveland, Ohio

Induction and Dielectric Heating Subcommittee

T. P. Kinn, *Chairman;* Westinghouse Electric Corp., 2519 Wilkens Avenue, Baltimore, Md.

C. A. Tudbury, *Secretary*	Cleveland, Ohio
R. M. Baker	Baltimore, Md.
C. P. Bosomworth	Akron, Ohio
John Bruggeman	Bloomfield, N. J.
Harold Bunte	Chicago, Ill.
E. W. Chapin	Laurel, Md.
F. T. Chesnut	Trenton, N. J.
J. E. Eiselein	Camden, N. J.
C. W. Frick	Schenectady, N. Y.
R. D. Gardner	Syracuse, N. Y.
Edward Goodridge	Brooklyn, N. Y.
W. H. Hickok	Louisville, Ky.
J. H. Hrovath	Cleveland, Ohio
C. A. Jorgensen	Kenosha, Wis.
F. H. Justin	Midland, Mich.
R. E. Kirby	Baltimore, Md.
K. E. Kjolseth	Schenectady, N. Y.
G. W. Klingaman	Camden, N. J.
Otto Kreiser	Newark, N. J.
R. V. Lackner	Pittsburgh, Pa.
B. E. McArthur	Youngstown, Ohio
J. W. Post	Milwaukee, Wis.
W. C. Rudd	New Rochelle, N. Y.
G. W. Scott, Jr.	Lancaster, Pa.
R. S. Segsworth	Toronto, Ont., Canada
J. T. Vaughan	Cleveland, Ohio
Otto Weitmann	New York, N. Y.
F. F. White	Wilmington, Del.
J. W. Williamson	Cleveland, Ohio

Radiant Heating Subcommittee

E. J. Bates, *Chairman;* National Cash Register Co., Dayton, Ohio

I. J. Barber	Fostoria, Ohio
Harold Bunte	Chicago, Ill.
P. H. Goodell	Detroit, Mich.
W. T. Gray, III	Philadelphia, Pa.
J. D. Hall	Bloomfield, N. J.
E. A. Linsday	Nela Park, Ohio
D. S. Pearson	State College, Pa.
E. B. Shand	Corning, N. Y.
R. G. Slauer	Salem, Mass.
L. A. Strobel	Detroit, Mich.
William Thompson	Pittsburgh, Pa.
W. H. Wannamaker	Philadelphia, Pa.

Technical Data Subcommittee

L. P. Hynes, *Chairman;* 36 West End Avenue, Haddonfield, N. J.

Harold Bunte	Chicago, Ill.
C. D. Fawcett	Philadelphia, Pa.
P. H. Goodell	Detroit, Mich.
C. F. Kreiser	Pittsburgh, Pa.
W. C. Russell	Pittsfield, Mass.
A. D. Spillman	Philadelphia, Pa.

Committee on Electric Welding

E. J. Limpel, *Chairman;* A. O. Smith Corp., Milwaukee 1, Wis.

J. F. Deffenbaugh, *Vice-Chairman*	Warren, Ohio
R. J. Krieger, *Secretary*	Henderson, Nev.
J. H. Blankenbuehler	Troy, Ohio
F. L. Brandt	Lynn, Mass.
J. W. Brown	Milwaukee, Wis.
C. R. Dixon	New Kensington, Pa.
M. A. Faucett	Decatur, Ill.
J. D. Ghesquiere	Detroit, Mich.
S. M. Kapell	Philadelphia, Pa.
W. B. Kouwenhoven	Baltimore, Md.
Charles Molenaar	Detroit, Mich.
C. E. Pflug	Kenosha, Wis.
L. C. Poole	Ferndale, Mich.
J. F. Randall	Dearborn, Mich.
R. P. C. Rasmusen	Columbus, Ohio
C. B. Stadum	Buffalo, N. Y.
E. F. Steinert	Buffalo, N. Y.
L. K. Stringham	Cleveland, Ohio
H. W. Tietze	Newark, N. J.
H. D. VanSciver	Philadelphia, Pa.
A. U. Welch, Jr.	York, Pa.
J. B. Welch	Milwaukee, Wis.
L. P. Winsor	Troy, N. Y.
R. E. Young	Kankakee, Ill.
Myron Zucker	Detroit, Mich.

Fundamental Arc Research Subcommittee

L. P. Winsor, *Chairman;* Rensselaer Polytechnic Institute, Department of Electrical Engineering, Troy, N. Y.

Robert Krieger, *Vice-Chairman*	Columbus, Ohio
J. H. Cahn	Columbus, Ohio
J. D. Cobine	Schenectady, N. Y.
R. E. Evans	Bridgeport, Conn.
Wolfgang Finkelnburg	
J. E. Forss	Chicago, Ill.
W. J. Greene	Murray Hill, N. J.
T. B. Jones	Baltimore, Md.
T. H. Lee	Schenectady, N. Y.
E. J. Limpel	Milwaukee, Wis.
S. F. Radtke	Newport, Del.
Bela Ronay	Annapolis, Md.
G. M. Skinner	Buffalo, N. Y.
C. G. Smith	Waltham, Mass.
Myron Zucker	Detroit, Mich.

Instrumentation for Resistance Welding Subcommittee

R. P. C. Rasmussen, *Chairman;* Battelle Memorial Institute, Columbus, Ohio

M. P. Cornelius, Jr.	Chicago, Ill.
J. F. Deffenbaugh	Warren, Ohio
C. R. Dixon	New Kensington, Pa.
J. D. Graham	East Pittsburgh, Pa.
S. M. Kapell	Philadelphia, Pa.
V. H. Kraybill	Maywood, Ill.
R. J. Krieger	Columbus, Ohio
E. J. Limpel	Milwaukee, Wis.
H. V. Nelson	Schenectady, N. Y.
Alex Paalu	Milwaukee, Wis.
J. F. Randall	Dearborn, Mich.
J. J. Riley	Warren, Ohio
C. F. Savage, Jr.	Lynn, Mass.
J. L. Solomon	Chicago, Ill.
H. D. VanSciver	Philadelphia, Pa.
J. B. Welch	Milwaukee, Wis.

Committee on Electronic Power Converters

August Schmidt, Jr., *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

J. B. Pitman, *Vice-Chairman*	Massena, N. Y.
J. K. Dillard, *Secretary*	East Pittsburgh, Pa.
B. D. Bedford	Schenectady, N. Y.
W. H. Bixby	Detroit, Mich.
W. F. Bonner	Clifton, N. J.
J. L. Boyer	East Pittsburgh, Pa.
E. F. Christensen	Pittsfield, Mass.
A. P. Colaiaco	East Pittsburgh, Pa.
I. K. Dortort	Philadelphia, Pa.
J. J. Dravis	Hamilton, Ont., Canada
S. R. Durand	San Francisco, Calif.
D. V. Edwards	Newark, N. J.
J. N. Fogg	Baton Rouge, La.
W. D. Garbutt	Montreal, Que., Canada
W. J. Gilson	Toronto, Ont., Canada
W. E. Gutzwiller	Milwaukee, Wis.
A. D. Hadley	Portland, Oreg.
C. S. Hague	East Pittsburgh, Pa.
R. N. Harder	Alcoa, Tenn.
C. C. Herskind	Schenectady, N. Y.
D. C. Hoffmann	Philadelphia, Pa.
Otto Jensen	Philadelphia, Pa.
F. D. Kaiser	Sharon, Pa.
W. R. Kettenring, Jr.	Schenectady, N. Y.
C. A. Longlois	Richmond, Va.
D. E. Marshall	Elmira, N. Y.
Kenneth McCaskill	Niagara Falls, N. Y.
M. M. Morack	Schenectady, N. Y.
L. W. Morton	Schenectady, N. Y.
J. B. Nayler	Isle Maligne, Que., Canada
Waldo Porter	Vancouver, Wash.
M. E. Reagan	East Pittsburgh, Pa.
E. J. Ramscheid	Schenectady, N. Y.
C. E. Rettig	Schenectady, N. Y.
W. J. L. Rupprecht	Midland, Mich.
M. A. Sareault	Providence, R. I.
W. C. Sealey	Milwaukee, Wis.
D. H. Smith	New York, N. Y.
F. W. Smith	Easton, Pa.
H. C. Stiner	Schenectady, N. Y.
W. A. Stelzer	Midland, Mich.
Paul Triplett	Milwaukee, Wis.
H. E. Weppler	New York, N. Y.
C. H. Willis	Princeton, N. J.
Harold Winograd	Milwaukee, Wis.
G. M. Zins	East Pittsburgh, Pa.

Administrative Subcommittee

Main Committee Officers

August Schmidt, Jr., *Chairman;* General Electric Company, Ind. Eng. Div., 1 River Road, Schenectady, N. Y.

J. B. Pitman, *Vice-Chairman*	Massena, N. Y.
J. K. Dillard, *Secretary*	East Pittsburgh, Pa.
I. K. Dortort, *Preceding Chairman*	Philadelphia, Pa.

Subcommittee Chairmen

B. D. Bedford	Schenectady, N. Y.
W. H. Bixby	Detroit, Mich.
Otto Jensen	Philadelphia, Pa.
M. M. Morack	Schenectady, N. Y.
J. B. Pitman	Massena, N. Y.
Waldo Porter	Vancouver, Wash.

Others

Harold Winograd	Milwaukee, Wis.

Papers & Speakers Subcommittee

M. M. Morack, *Chairman;* General Electric Company, 1 River Road, Schenectady, N. Y.

A. P. Colaiaco	East Pittsburgh, Pa.
H. E. Zuvers	Schenectady, N. Y.

Electronic Converter Circuits Subcommittee

B. D. Bedford, *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

W. H. Bixby	Detroit, Mich.
W. F. Boner	Clifton, N. J.
J. L. Boyer	East Pittsburgh, Pa.
E. F. Christensen	Pittsfield, Mass.
A. P. Colaiaco	East Pittsburgh, Pa.
E. J. Diebold	Philadelphia, Pa.
J. K. Dillard	East Pittsburgh, Pa.
I. K. Dortort	Philadelphia, Pa.
F. D. Kaiser	Sharon, Pa.
M. E. Reagan	East Pittsburgh, Pa.
C. E. Rettig	Schenectady, N. Y.
W. C. Sealey	Milwaukee, Wis.
C. H. Willis	Princeton, N. J.
Forrest Woodland, Jr.	New York, N. Y.

Mercury Arc Converter Subcommittee

J. B. Pitman, *Chairman;* Aluminum Co. of America, 42 Park Avenue, Massena, N. Y.

J. L. Boyer	East Pittsburgh, Pa.
E. H. Coxe, Jr.	Baton Rouge, La.
F. W. Cramer	Pittsburgh, Pa.
I. K. Dortort	Philadelphia, Pa.
J. J. Dravis	Hamilton, Ont., Canada
W. E. Gutzwiller	Milwaukee, Wis.
C. C. Herskind	Schenectady, N. Y.
R. N. Hunter	New York, N. Y.
Armin Leuthold	Montreal, Que., Canada
C. R. Marcum	Pittsburgh, Pa.
M. M. Morack	Schenectady, N. Y.
E. J. Remscheid	Schenectady, N. Y.
W. A. Stelzer	Midland, Mich.
O. J. Swanson	Gary, W. Va.
Harold Winograd	Milwaukee, Wis.
G. M. Zins	East Pittsburgh, Pa.

Mechanical Rectifier Subcommittee

Otto Jensen, *Chairman;* I-T-E Circuit Breaker Co., 501 North 19th St., Philadelphia, Pa.

E. J. Diebold	Philadelphia, Pa.
W. J. Gilson	Toronto, Ont., Canada
D. C. Hoffmann	Philadelphia, Pa.
D. H. Smith	New York, N. Y.

West Coast Subcommittee

Waldo Porter, *Chairman;* Aluminum Co. of America, P. O. Box 120, Vancouver, Wash.

W. M. Allen	Portland, Oreg.
E. D. Barcus	Los Angeles, Calif.
H. L. Burris	Pittsburg, Calif.
W. C. Clark	Pittsburg, Calif.
R. J. Corfield	Garfield, Utah
J. H. Cox	Sunnyvale, Calif.
R. H. Denyer	Portland, Oreg.
A. G. Dickinson	Trail, B. C., Canada
E. F. Donatic	Ontario, Calif.
Alexander Dovjikov	Portland, Oreg.
S. R. Durand	San Francisco, Calif.
L. E. Dye	Los Angeles, Calif.
M. M. Ewell	Portland, Oreg.
T. F. Hadwin	Vancouver, B. C., Canada
D. R. Hoopes	Salt Lake City, Utah

J. V. Kresser	San Francisco, Calif.
H. F. Lickey	Pullman, Wash.
A. L. Munn	San Leandro, Calif.
S. J. Pope	Spokane, Wash.
K. L. Scott	San Francisco, Calif.
H. H. Skilling	Stanford, Calif.
E. C. Starr	Corvallis, Oreg.
R. B. Stewart	Los Angeles, Calif.
H. V. Strandberg	Seattle, Wash.

Working Group on Protection of Electronic Power Converters

B. D. Bedford, *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

M. S. Carlson	Philadelphia, Pa.
W. R. Crites	Schenectady, N. Y.
K. Dillard	East Pittsburgh, Pa.
I. K. Dortort	Philadelphia, Pa.
C. E. Rettig	Schenectady, N. Y.
August Schmidt, Jr.	Schenectady, N. Y.
Harold Winograd	Milwaukee, Wis.

Committee on Feedback Control Systems

H. W. Cory, *Chairman;* Allis-Chalmers Mfg. Co., Hawley Works, Milwaukee 14, Wis.

J. R. Ragazzini, *Vice-Chairman*	New York, N. Y.
R. P. Forrestal, *Secretary*	Milwaukee, Wis.
W. R. Ahrendt	College Park, Md.
R. G. Beadle	Schenectady, N. Y.
E. R. Behn	New York, N. Y.
G. S. Brown	Cambridge, Mass.
J. T. Carleton	East Pittsburgh, Pa.
F. E. Crever	Schenectady, N. Y.
W. R. Evans	Downey, Calif.
F. H. Ferguson	Washington, D. C.
J. G. Ferguson	Murray Hill, N. J.
H. L. Flowers	Akron, Ohio
L. C. Harriott	Schenectady, N. Y.
S. W. Herwald	Baltimore, Md.
T. J. Higgins	Madison, Wis.
C. K. Hooper	Baltimore, Md.
R. M. Hutchinson	Philadelphia, Pa.
A. W. Jacobson	Waterbury, Conn.
R. W. Jones	Evanston, Ill.
L. F. Kazda	Ann Arbor, Mich.
A. G. Kegel	Baltimore, Md.
R. J. Kochenburger	Storrs, Conn.
O. W. Livingston	Schenectady, N. Y.
E. J. Luoma	Cleveland, Ohio
J. H. Macintyre	West Lynn, Mass.
C. J. Manner	Los Angeles, Calif.
H. T. Marcy	Endicott, N. Y.
R. C. McMaster	Columbus, Ohio
C. W. Miller	Norwalk, Conn.
R. W. Moore	Buffalo, N. Y.
Arthur Porter	Toronto, Ont., Canada
F. S. Rothe	Schenectady, N. Y.
R. M. Saunders	Cambridge, Mass.
O. H. Schuck	Minneapolis, Minn.
O. J. M. Smith	Sao Paulo, Brazil
G. L. Stancliff, Jr.	Washington, D. C.
T. M. Stout	Ridgefield, Conn.
K. O. Straney	Lynn, Mass.
W. H. Surber, Jr.	Princeton, N. J.
H. I. Tarpley	State College, Pa.
F. W. Tatum	Dallas, Texas
A. R. Teasdale	Forth Worth, Texas
F. C. Weimer	Columbus, Ohio
H. K. Weiss	Hawthorne, Calif.
C. N. Weygandt	Philadelphia, Pa.
O. D. Whitwell	Cleveland, Ohio
A. J. Williams, Jr.	Philadelphia, Pa.
C. H. Wilts	Pasadena, Calif.
Felix Zweig	New Haven, Conn.

Terminology and Nomenclature Subcommittee

(*Personnel to be selected*)

Bibliography Subcommittee

(*Personnel to be selected*)

Committee on General Industry Applications

F. D. Snyder, *Chairman;* Westinghouse Electric Corp., 40 Wall Street, New York 5, N. Y.

E. M. Hays, *Vice-Chairman*	Pittsburgh, Pa.
B. T. Anderson, *Secretary*	Rockford, Ill.
H. E. Ankeney	Fond du Lac, Wis.
A. T. Bacheler	Buffalo, N. Y.
S. A. Bobe	Atlanta, Ga.
J. J. W. Brown	Schenectady, N. Y.
O. M. Bundy	Cleveland, Ohio
R. H. Clark	Cleveland, Ohio
Swaffield Cowan	Charlotte, N. C.
J. M. Delfs	Schenectady, N. Y.
R. J. Demartini	Rensselaer, N. Y.
M. H. Fisher	East Pittsburgh, Pa.
A. W. Frankenfield	Wilmington, Del.
J. L. Fuller	Cleveland, Ohio
E. A. Johnson	New Haven, Conn.
V. O. Johnson	New York, N. Y.
J. R. Jowett	Welland, Ont., Canada
G. W. Knapp	Schenectady, N. Y.
A. F. Lukens	Lynn, Mass.
H. B. Mathieu	Lubbock, Texas
J. D. McConnell	Greensboro, N. C.
E. F. Mekelburg	Milwaukee, Wis.
J. F. Moore	Toronto, Ont., Canada
D. R. Percival	Northboro, Mass.
Kennard Pinder	Wilmington, Del.
G. E. Plaisted	San Francisco, Calif.
Samuel Rifkin	Schenectady, N. Y.
C. B. Risler	East Pittsburgh, Pa.
H. A. Rose	Seattle, Wash.
A. G. Seifried	Akron, Ohio
Victor Sepavich	Worcester, Mass.
Ray Stroppel	Cincinnati, Ohio
V. S. Sywulka	Milwaukee, Wis.
K. O. Tech	Detroit, Mich.
Fred Thompson	Seattle, Wash.
J. A. Tudor	Seattle, Wash.
W. S. Watkins	Willoughby, Ohio

Textile Subcommittee

Victor F. Sepavich, *Chairman;* Crompton & Knowles Loom Works, 93 Grand Street, Worcester 1, Mass.

J. D. McConnell, *Vice-Chairman*	Greensboro, N. C.
S. A. Bobe, *Secretary*	Atlanta, Ga.
A. T. Bacheler	Buffalo, N. Y.
Swaffield Cowan	Charlotte, N. C.
M. R. Brice	Milwaukee, Wis.
I. S. Bull, Jr.	Gastonia, N. C.
R. H. Clark	Cleveland, Ohio
H. S. Colbath	Macon, Ga.
R. J. Demartini	Rensselaer, N. Y.
R. B. Flowers	Atlanta, Ga.
A. W. Frankenfield	Wilmington, Del.
G. C. Gaskin	Charlotte, N. C.
W. W. Hammond	Charlotte, N. C.
C. F. Hedlund	Boston, Mass.
J. H. Lampe	Raleigh, N. C.
J. T. Meador	Charlotte, N. C.
R. R. Prechter	Schenectady, N. Y.
C. E. Robinson	Cleveland, Ohio
F. D. Snyder	New York, N. Y.
J. W. Ward	Sylacauga, Ala.
R. S. White	Providence, R. I.

Rubber and Plastics Subcommittee

W. S. Watkins, *Chairman;* The Ohio Rubber Company, Willoughby, Ohio

M. H. Fisher, *Secretary*	East Pittsburgh, Pa.
L. E. Buess	Akron, Ohio
O. M. Bundy	Cleveland, Ohio
K. W. John	Detroit, Mich.
L. F. Lewis	Schenectady, N. Y.
J. F. Moore	Toronto, Ont., Canada
A. G. Payne	Springfield, Mass.
P. T. Powell	Passaic, N. J.
C. E. Robinson	Cleveland, Ohio
E. T. Scholze	Akron, Ohio
A. G. Seifried	Akron, Ohio
R. F. Snyder	Akron, Ohio
V. S. Sywulka	Milwaukee, Wis.
F. C. Timberman	Akron, Ohio
E. W. Wilson	Cleveland, Ohio

Paper and Pulp Subcommittee

S. A. Bobe, *Chairman;* Westinghouse Electric Corp., P. O. Box 4808, Atlanta 2, Ga.

H. B. Barrow	Atlanta, Ga.
R. C. Berger	Cleveland, Ohio
G. I. Burner	Pittsburgh, Pa.
S. J. Campbell	East Pittsburgh, Pa.
T. A. Likos	Boston, Mass.
C. J. Meloun	Schenectady, N. Y.
E. K. Murphy	New York, N. Y.
M. J. Osborne	Calhoun, Tenn.
H. M. Reed	Mobile, Ala.
M. M. Stokely	Greenville, S. C.

Machine Tools Subcommittee

K. O. Tech, *Chairman;* The Cross Company, 3250 Bellevue Avenue, Detroit 7, Mich.

R. E. Stroppel, *Vice-Chairman*	Cincinnati, Ohio
H. E. Ankeney	Fond du Lac, Wis
J. P. Bellafaire	Detroit, Mich
E. E. Carlton	San Francisco, Calif
R. H. Clark	Cleveland, Ohio
W. P. Curtis	Dearborn, Mich
J. M. Delfs	Schenectady, N. Y
X. F. deSostoa	Detroit, Mich
R. N. Eck	Milwaukee, Wis
J. I. Ehrhardt	Detroit, Mich
F. L. Fisher	Milwaukee, Wis
C. G. Helmick	East Pittsburgh, Pa
V. F. Hill	Providence, R. I
J. J. Jaeger	West Hartford, Conn
V. R. Murphy	Cleveland, Ohio
E. J. Rivoira	Cincinnati, Ohio
T. A. Wetzel	Milwaukee, Wis

Pacific Coast Subcommittee

H. A. Rose, *Chairman;* Westinghouse Electric Corp., 3451 E. Marginal Way, Seattle, Wash.

Fred Thompson, *Vice-Chairman*	Seattle, Wash.
Frank Alexander	Vancouver, B. C., Canada
E. S. Dibble	Los Angeles, Calif.
L. R. Gregor	Camas, Wash.
C. S. Homer	Port Angeles, Wash.
G. R. Plaisted	San Francisco, Calif.
N. H. Rayner	Everett, Wash.
A. L. Scott	Portland, Oreg.
D. S. Smith	Vancouver, B. C., Canada
C. J. Spain, Jr.	San Francisco, Calif.
H. E. Springer	Port Angeles, Wash.
J. A. Tudor	Seattle, Wash.
K. D. Watt	Vancouver, B. C., Canada

Materials Handling Subcommittee

J. J. W. Brown, *Chairman;* General Electric Co., Schenectady 5, N. Y.

R. P. Anderson	Wickliffe, Ohio
H. H. Angel	Bethlehem, Pa.
H. W. Ball	Alliance, Ohio
E. L. Blankenbeker	Pittsburgh, Pa.
F. M. Blum	Milwaukee, Wis.
C. Brongersma	Muskegon, Mich.
B. H. Carlisle	Cleveland, Ohio
D. C. Gray	St. Paul, Minn.
W. J. Heacock	Chicago, Ill.
L. E. Jensen	Tacoma, Wash.
W. E. Lawton	Pittsburgh, Pa.
J. D. Leitch	Cleveland, Ohio
J. A. Miller	Philadelphia, Pa.
H. A. Neubert	Philadelphia, Pa.
E. J. Posselt	Milwaukee, Wis.
R. F. Rice	Harvey, Ill.
Samuel Rifkin	Schenectady, N. Y.
C. B. Risler	East Pittsburgh, Pa.
E. J. Sohn	Bedford, Ind.
R. E. Stephan	Pittsburgh, Pa.
F. K. Tanner	Alliance, Ohio
J. P. Wagstaff	Washington, D. C.

Committee on Industrial Control

H. L. Palmer, *Chairman;* General Electric Co., Specialty Control Dept., Bldg. 81, 1 River Road, Schenectady 5, N. Y.

L. H. Matthias, *Vice-Chairman*	Milwaukee, Wis.
J. W. Picking, *Secretary*	Cleveland, Ohio
W. A. Alvarez	Schenectady, N. Y.
T. H. Bloodworth	Milwaukee, Wis.
J. A. Cortelli	Cleveland, Ohio
E. F. Drake	Port Townsend, Wash.
W. H. Elliot	Milwaukee, Wis.
C. T. Evans	Milwaukee, Wis.
H. G. Frostick	Pittsburgh, Pa.
J. E. Gahagan	Binghamton, N. Y.
J. A. Gienger	Rochester, N. Y.
Albert Hansen, Jr.	Lynn, Mass.
Walter Hansen	Boston, Mass.
T. J. Hoffman	Canton, Ohio
A. M. Hopkin	Berkeley, Calif.
J. J. Jaeger	West Hartford, Conn.
R. W. Jones	Evanston, Ill.
E. J. Limpel	Milwaukee, Wis.
O. W. Livingston	Schenectady, N. Y.
W. B. Mann	Baltimore, Md.
C. E. McRoberts	Toronto, Ont., Canada
E. F. Mekelburg	Milwaukee, Wis.
R. W. Moore	Buffalo, N. Y.
J. M. Morgan	Cincinnati, Ohio
E. E. Moyer	Poughkeepsie, N. Y.
A. H. Myles	Cleveland, Ohio
J. J. O'Connor	New York, N. Y
S. C. Phillips	Peterboro, Ont., Canada
D. L. Pierce	Buffalo, N. Y
Garfield Pritchard	Naugatuck, Conn
F. E. Strauss	Oakland, Calif
H. R. Walker	Midland, Mich

Electronic Control Subcommittee

W. H. Elliot, *Chairman;* Cutler-Hammer, Inc., 315 North 12th Street, Milwaukee 1, Wis.

R. C. Booth	Danville, Ill.
P. J. Cade	Cambridge, Mass.
Benjamin Cooper	Schenectady, N. Y.
William Few	Goshen, Ind.
W. E. Large	Buffalo, N. Y.
M. H. A. Lindsay	New York, N. Y.
E. B. McDowell	Schenectady, N. Y.
E. E. Moyer	Poughkeepsie, N. Y.
R. W. Pfaff	Cleveland, Ohio
J. W. Picking	Cleveland, Ohio
E. D. Schneider	Schenectady, N. Y.
F. L. Slamar	Buffalo, N. Y.
E. H. Vedder	Buffalo, N. Y.
H. R. Walker	Midland, Mich.
W. M. Walthall	Danville, Ill.

Papers Review Subcommittee

L. H. Matthias, *Chairman;* Allen-Bradley Company, 136 West Greenfield Ave., Milwaukee 4, Wis.

T. H. Bloodworth	Milwaukee, Wis.
W. H. Elliot	Milwaukee, Wis.
F. Y. Grepe	Toronto, Ont., Canada
W. A. Hunter	Schenectady, N. Y.
R. W. Moore	Buffalo, N. Y.
A. H. Myles	Cleveland, Ohio

Standards Subcommittee

W. A. Alvarez, *Chairman;* General Electric Company, 1 River Road, Bldg. 69, Schenectady 5, N. Y.

J. A. Gienger	Rochester, N. Y.
J. J. Jaeger	West Hartford, Conn.
A. H. Myles	Cleveland, Ohio

Test Codes Subcommittee

C. T. Evans, *Chairman;* Cutler-Hammer, Inc., 315 North 12th Street, Milwaukee 1, Wis.

D. K. Frost	Rockford, Ill.
F. C. Inglehart	Buffalo, N. Y.
W. E. Pakala	East Pittsburgh, Pa.
H. E. Rhoads	Schenectady, N. Y.
C. A. Schaefer	Milwaukee, Wis.

Regulators and Feedback Systems Subcommittee

O. W. Livingston, *Chairman;* General Electric Co., 1 River Road, Bldg. 81, Schenectady, N. Y.

E. T. Davis	Philadelphia, Pa.
William Few	Goshen, Ind.
J. W. Picking	Cleveland, Ohio
E. H. Vedder	Buffalo, N. Y.

Committee on Industrial Power Systems

S. A. Warner, *Chairman;* Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York 3, N. Y.

R. H. Whaley, *Vice-Chairman*	Indianapolis, Ind.
R. T. Woodruff, *Secretary*	Pittsburgh, Pa.
H. H. Angel	Bethlehem, Pa.
Glen Bates	Seattle, Wash.
D. L. Beeman	Schenectady, N. Y.
H. A. Bergen	St. Joseph, Mich.
W. C. Bloomquist	Schenectady, N. Y.
Edward Bond, Jr.	Niagara Falls, N. Y.
A. M. Buck	Everett, Wash.
J. P. Conner	San Diego, Calif.
E. E. Dale	Seattle, Wash.
William Deans	Philadelphia, Pa.
Leo Dolkart	Chicago, Ill.
F. M. Dorey	Los Angeles, Calif.
W. J. Ellenberger	Washington, D. C.
F. W. Enoch, Jr.	Monsanto, Ill.
R. A. Erwin	Los Angeles, Calif.
C. J. Firth	Philadelphia, Pa.
L. E. Fisher	Plainville, Conn.
A. C. Friel	Midland, Mich.
F. S. Glaza	Freeport, Texas
W. S. Gordon	Tacoma, Wash.
F. A. Green	Akron, Ohio
T. W. Haymes	Norco, La.
A. W. Howard	Fort Wayne, Ind.
C. R. Johnson	New York, N. Y.
H. D. Keefer	Port Lavaca, Texas
C. M. Lathrop	Linden, N. J.
J. G. Lucas	Peterboro, Ont., Canada
A. E. Marshall	St. Louis, Mo.
C. I. Maust	New York, N. Y.
J. V. McGuire	Milwaukee, Wis.
R. R. Nisley	New York, N. Y.
J. J. O'Connor	New York, N. Y.
E. P. Peabody	Richland, Wash.
J. L. Phillips	Birmingham, Ala.
A. E. Pringle	Philadelphia, Pa.
C. E. Quick	Detroit, Mich.
R. H. Rankin	Rochester, N. Y.
C. C. Saunders	Wilmington, Del.
D. W. Scruggs	Alcoa, Tenn.
H. S. Shott	Denver, Colo.
H. E. Springer	Port Angeles, Wash.
T. O. Sweatt	New York, N. Y.
H. B. Thacker	East Pittsburgh, Pa.
B. F. Thomas, Jr.	New York, N. Y.
Fred Thompson	Seattle, Wash.
H. W. Tietze	Newark, N. J.
R. C. Waldron	Passaic, N. J.
E. F. Wehr	Cleveland, Ohio
T. O. Zittel	Lackawanna, N. Y.

Executive Subcommittee

S. A. Warner, *Chairman;* Consolidated Edison Co. of N. Y., Inc., 4 Irving Place, New York 3, N. Y.

R. H. Whaley, *Vice-Chairman*	Indianapolis, Ind.
R. T. Woodruff, *Secretary*	Pittsburgh, Pa.
Glenn Bates	Seattle, Wash.
D. L. Beeman	Schenectady, N. Y.
R. R. Nisley	New York, N. Y.
A. E. Pringle	Philadelphia, Pa.
B. F. Thomas, Jr.	New York, N. Y.

Electric Power Distribution for Industrial Plants Booklet Subcommittee

R. R. Nisley, *Chairman;* Westinghouse Electric Corp., 40 Wall Street, New York 5, N. Y.

H. H. Angel	Bethlehem, Pa.
W. C. Bloomquist	Schenectady, N. Y.
D. S. Brereton	Schenectady, N. Y.
William Deans	Philadelphia, Pa.
W. J. Ellenberger	Washington, D. C.
W. S. Gordon, Jr.	Tacoma, Wash.
T. W. Haymes	Norco, La.
C. R. Johnson	New York, N. Y.
R. H. Kaufmann	Schenectady, N. Y.
C. M. Lathrop	Linden, N. J.
J. V. McGuire	Milwaukee, Wis.
J. L. Phillips	Birmingham, Ala.
C. E. Quick	Detroit, Mich.
T. O. Sweatt	New York, N. Y.
H. B. Thacker	East Pittsburgh, Pa.
B. F. Thomas, Jr.	New York, N. Y.
R. C. Waldron	Passaic, N. J.
S. A. Warner	New York, N. Y.
J. W. Yetter	Schenectady, N. Y.

Codes and Standards Subcommittee

A. E. Pringle, *Chairman;* Pringle Electrical Mfg. Co., 1906 N. 6th Street, Philadelphia 22, Pa.

Glenn Bates	Seattle, Wash.
J. D. Brooks	Washington, D. C.
Leo Dolkart	Chicago, Ill.
W. J. Ellenberger	Washington, D. C.
R. A. Erwin	Los Angeles, Calif.
F. E. Strauss	Oakland, Calif.
J. J. Tesoriero	New York, N. Y.

Industrial Grounding Subcommittee

D. L. Beeman, *Chairman;* General Electric Co., Schenectady, N. Y.

H. H. Angel	Bethlehem, Pa.
M. A. Leyland	Norwalk, Conn.
C. C. Saunders	Wilmington, Del.
H. B. Thacker	East Pittsburgh, Pa.

Distribution Systems for Commercial Building Subcommittee

C. I. Maust, *Chairman;* Voorhees, Walker, Foley & Smith, 101 Park Avenue, New York, N. Y.

D. M. Allison	Tulsa, Okla.
Glenn Bates	Seattle, Wash.
D. L. Beeman	Schenectady, N. Y.
Philmore Belsky	Los Angeles, Calif.
H. A. Bergen	St. Joseph, Mich.
A. J. Bisson	New York, N. Y.
W. C. Bloomquist	Schenectady, N. Y.
Edward Bond, Jr.	Niagara Falls, N. Y.
A. M. Buck	Everett, Wash.
Allan Coggeshall	New York, N. Y.
J. P. Conner	San Diego, Calif.
W. C. Deans	Philadelphia, Pa.
Leo Dolkart	Chicago, Ill.
H. J. Donnelly	Albany, N. Y.
R. A. Erwin	Los Angeles, Calif.
L. E. Fisher	Southington, Conn.
F. S. Glaza	Freeport, Texas
F. A. Green	Akron, Ohio
W. S. Gordon	Tacoma, Wash.
C. R. Johnson	New York, N. Y.
H. D. Kurt	Schenectady, N. Y.
J. J. O'Connor	New York, N. Y.
C. E. Quick	Detroit, Mich.
C. C. Saunders	Wilmington, Del.
D. W. Scruggs	Alcoa, Tenn.
H. S. Shott	Denver, Colo.
B. F. Thomas, Jr.	New York, N. Y.
Fred Thompson	Seattle, Wash.
H. W. Tietze	Newark, N. J.
E. F. Wehr	Cleveland, Ohio
A. C. Youngson	New York, N. Y.

Pacific Coast Subcommittee

Glenn Bates, *Chairman;* Westinghouse Electric Corp., 3451 East Marginal Way, Seattle 4, Wash.

A. M. Buck	Everett, Wash.
J. P. Conner	San Diego, Calif.
E. E. Dale	Seattle, Wash.
F. M. Dorey	Los Angeles, Calif.
R. A. Erwin	Los Angeles, Calif.
W. S. Gordon, Jr.	Tacoma, Wash.
E. P. Peabody	Richland, Wash.
H. E. Springer	Port Angeles, Wash.
Fred Thompson	Seattle, Wash.

Committee on Mining and Metal Industry

W. R. Harris, *Chairman;* Westinghouse Electric Corp., Industry Engrg. Dept. 11L49, East Pittsburgh, Pa.

R. B. Moore, *Vice-Chairman*	Schenectady, N. Y.
J. E. Arberry	Pittsburgh, Pa.
H. W. Biskeborn	Ansonia, Conn.
W. K. Boice	New Haven, Conn.
J. E. Breth	Fairfield, Ala.
L. E. Briscoe	Indianapolis, Ind.
E. H. Browning	East Pittsburgh, Pa.
J. A. Buss	Cleveland, Ohio
R. L. Chapman	Erie, Pa.
R. J. Corfield	Garfield, Utah
E. W. Davis	Cambridge, Mass.
J. A. Dunn	Holden, W. Va.
J. H. Edwards	New York, N. Y.
Sam Ein	East Chicago, Ind.
Cecil Farrow	Cleveland, Ohio
E. E. Gaston	Adena, Ohio
E. J. Gleim	Pittsburgh, Pa.
Lanier Greer	Cleveland, Ohio
L. N. Grier	Pittsburgh, Pa.
C. L. Gust	Lead, S. Dak.
L. H. Harrison	Birmingham, Ala.
F. R. Hugus	Franklin, Pa.
E. H. Hulse	East Pittsburgh, Pa.
J. G. Ivy	Chicago, Ill.
L. H. James	Scranton, Pa.
G. F. Johnson	Michigan City, Ind.
H. L. Lindsey	Charleston, W. Va.
W. E. Miller	Schenectady, N. Y.
T. B. Montgomery	Milwaukee, Wis.
A. C. Muir	Philadelphia, Pa.
H. P. Musser	Charleston, W. Va.
C. A. Poppino	Phoenix, Ariz.
B. E. Price	Columbus, Ohio
G. B. Scheer	Oakland, Calif.
F. O. Schnure	Sparrows Point, Md.
Victor Siegfried	Worcester, Mass.
G. O. Wardrop	South Charleston, W. Va.
T. R. Weichel	Wilkes-Barre, Pa.
J. R. Wickey	Cleveland, Ohio
C. O. Wood	Chicago, Ill.

Metal Industries Subcommittee

F. O. Schnure, *Chairman;* Bethlehem Steel Corp., Sparrows Point 19, Md.

W. E. Miller, *Secretary*	Schenectady, N. Y.
J. E. Arberry	Pittsburgh, Pa.
H. W. Biskeborn	Newark, Ohio
E. H. Browning	East Pittsburgh, Pa.
R. M. Carson	San Francisco, Calif.
J. A. Cortelli	Cleveland, Ohio
F. W. Cramer	Pittsburgh, Pa.
E. F. Donatic	Fontana, Calif.
Sam Ein	East Chicago, Ind.
Cecil Farrow	Cleveland, Ohio
R. I. Greenwood	Los Angeles, Calif.
Lanier Greer	Cleveland, Ohio
L. N. Grier	Pittsburgh, Pa.
W. R. Harris	East Pittsburgh, Pa.
G. A. Hornbecker	Waterbury, Conn.
D. C. McCrady	Hamilton, Ont., Canada
T. B. Montgomery	Milwaukee, Wis.

E. H. Myers	East Pittsburgh, Pa.
B. E. Price	Columbus, Ohio
G. B. Scheer	Oakland, Calif.
E. G. Schlup	Middletown, Ohio
Victor Siegfried	Worcester, Mass.
S. V. Stickler, Jr.	Philadelphia, Pa.
J. R. Wickey	Cleveland, Ohio

Eastern Mining Subcommittee

R. B. Moore, *Chairman;* Mining-Indus. Engrg. Divs., General Electric Co., Schenectady 5, N. Y.

C. O. Wood, *Secretary*	Chicago, Ill.
J. E. Breth	Fairfield, Ala.
L. E. Briscoe	Indianapolis, Ind.
J. A. Buss	Cleveland, Ohio
R. L. Chapman	Erie, Pa.
E. W. Davis	Cambridge, Mass.
J. A. Dunn	Holden, W. Va.
J. H. Edwards	New York, N. Y.
E. E. Gaston	Adena, Ohio
E. J. Gleim	Pittsburgh, Pa.
L. H. Harrison	Birmingham, Ala.
F. R. Hugus	Franklin, Pa.
E. H. Hulse	Salt Lake City, Utah
G. F. Johnson	Michigan City, Ind.
H. L. Lindsey	Charleston, W. Va.
A. C. Muir	Philadelphia, Pa.
H. P. Musser	Charleston, W. Va.
R. R. Richart	Benton, Ill.
G. O. Wardrop	South Charleston, W. Va.
T. R. Weichel	Wilkes-Barre, Pa.

Western Mining Subcommittee

A. B. Chafetz, *Chairman;* International Min. & Chem. Corp., Potash Division, Carlsbad, N. Mex.

C. A. Poppino, *Secretary*	Phoenix, Ariz.
C. H. Bailey	Duluth, Minn.
J. L. Bauer	Denver, Colo.
R. J. Corfield	Garfield, Utah
R. M. Gilbert	Spokane, Wash.
T. M. Googin	San Francisco, Calif.
C. L. Gust	Lead, S. Dak.
R. H. Hartley	Phoenix, Ariz.
E. H. Hulse	Salt Lake City, Utah
J. G. Ivy	Chicago, Ill.
J. O. Kammerman	Rapid City, S. Dak.
H. R. Lloyd	Salt Lake City, Utah
R. E. Martin	Inspiration, Ariz.

Committee on Petroleum Industry

J. Z. Linsenmeyer, *Chairman;* Westinghouse Electric Corp., 306 Fourth Avenue, P. O. Box 1017, Pittsburgh 30, Pa.

V. J. Sittel, *Vice-Chairman*	Tulsa, Okla.
E. H. Hulse, *Secretary*	East Pittsburgh, Pa.
J. R. Ashley	Dallas, Texas
N. W. Beaudreau	Corpus Christi, Texas
E. C. Benjamin	New York, N. Y.
R. E. Burlingame	Kansas City, Mo.
R. S. Cannon	Atlanta, Ga.
A. J. Claes	East St. Louis, Ill.
Carl Cross	Phillips, Texas
R. F. Danner	Oklahoma City, Okla.
W. H. Dickinson	Linden, N. J.
L. B. Eddy	Des Plaines, Ill.
C. W. Edmundson	Kansas City, Mo.
H. M. Furtney	Tulsa, Okla.
L. M. Goldsmith	Philadelphia, Pa.
A. R. Heidelbrecht	Kansas City, Mo.
J. H. Heller	Tulsa, Okla.
W. F. Hildebrand	Tulsa, Okla.
C. C. Homan, Jr.	El Paso, Texas
E. R. Hoyle	East Chicago, Ind.
M. A. Hyde	East Pittsburgh, Pa.
M. L. Lippert	Kansas City, Mo.
J. O. Mostrom	Bartlesville, Okla.
V. G. Murdock	West Allis, Wis.
L. E. Oberhelman	Sugar Creek, Mo.
D. M. Poundstone	Borger, Texas
G. A. Smith	Tulsa, Okla.
W. H. Stueve	Oklahoma City, Okla.
R. J. Thompson	Oklahoma City, Okla.
R. E. Thornton	Oklahoma City, Okla.
F. H. Walker	Philadelphia, Pa.
H. A. Wright	West Allis, Wis.

Production Subcommittee

J. R. Ashley, *Chairman;* Magnolia Pipe Line Co., P. O. Box 900, Dallas 21, Texas

(Personnel to be selected at a later date)

Transportation Subcommittee

R. S. Cannon, *Chairman;* Plantation Pipe Line Co., P. O. Box 1743, Atlanta 1, Ga.

(Personnel to be selected at a later date)

Refining Subcommittee

W. H. Dickinson, *Chairman;* Standard Oil Development Company, Linden, N. J.

(Personnel to be selected at a later date)

Power Division

Power Division Committee

B. G. A. Skrotzki, *Chairman;* "Power", 330 West 42nd Street, New York 36, N. Y.

C. T. Hatcher, *Vice-Chairman*	New York, N. Y.
R. S. Gardner, *Secretary*	New York, N. Y.
J. A. Adams	Philadelphia, Pa.
F. R. Benedict *(Representing Board of Directors)*	Boston, Mass.
A. A. Browne	San Francisco, Calif.
W. R. Brownlee	Birmingham, Ala.
A. P. Hayward	Pittsburgh, Pa.
L. F. Kennedy	Schenectady, N. Y.
W. A. Lewis, Jr.	Chicago, Ill.
S. C. Leyland	Newark, N. J.
J. B. McClure	Schenectady, N. Y.
M. H. McGrath	Perth Amboy, N. J.
I. S. Mendenhall	Detroit, Mich.
E. G. Norell	Chicago, Ill.
E. I. Pollard	Ridgway, Pa.
F. V. Smith	Chicago, Ill.
C. G. Veinott	Cleveland, Ohio
Frank von Roeschlaub	New York, N. Y.
C. F. Wagner	East Pittsburgh, Pa.
E. F. Weaver	Hazleton, Pa.
J. D. Wood	Philadelphia, Pa.

Committee on Carrier Current

S. C. Leyland, *Chairman;* Westinghouse Electric Corp., 95 Orange Street, Newark 1, N. J.

L. G. Eaton, *Vice-Chairman (East)*	Boston, Mass.
L. E. Ludekens, *Vice-Chairman (West)*	Los Angeles, Calif.
H. W. Lensner, *Secretary*	Newark, N. J.
J. F. Atkinson	Washington, D. C.
S. C. Bartlett	New York, N. Y.
T. M. Blakeslee	Los Angeles, Calif.
W. H. Blankmeyer	Butte, Mont.
C. W. Boadway	Toronto, Ont., Canada
J. R. Boston	Portland, Oreg.
R. L. Brinton	San Francisco, Calif.
LaVerne Carter	Portland, Oreg.
T. A. Cramer	Schenectady, N. Y.
J. A. Doremus	Plainville, Conn.
J. R. Ellison	Oklahoma City, Okla.
J. L. Evans	Manchester, N. H.
G. E. Farmer	Chattanooga, Tenn.
G. B. Gilcrest	San Francisco, Calif.
F. B. Gunter	Baltimore, Md.
E. W. Kenefake	Syracuse, N. Y.
L. F. Kennedy	Schenectady, N. Y.
E. S. Kocsan	Johnstown, Pa.
S. S. Lesh	Hazelton, Pa.
N. M. Levinson	North Adams, Mass.
R. W. Lewis	Boston, Mass.
Samuel Lubin	North Adams, Mass.
T. W. MacLean	Spokane, Wash.
J. D. Moynihan	East Pittsburgh, Pa.
Basil Payne	Augusta, Maine
D. C. Pinkerton	Syracuse, N. Y.
L. R. Preston	Chicago, Ill.
J. W. Savage	Los Angeles, Calif.
H. J. Sutton	Beaumont, Texas
L. G. Walker	Chicago, Ill.
Mead Waren, Jr.	Alcoa, Tenn.
W. J. Wortman	Charlotte, N. C.
Jean Youngblood	Detroit, Mich.

Executive Subcommittee

C. W. Boadway, *Chairman;* Hydro-Electric Power Commission of Ontario, 620 University Avenue, Toronto, Ont., Canada

T. A. Cramer	Schenectady, N. Y.
L. G. Eaton	Boston, Mass.
F. B. Gunter	Baltimore, Md.
H. W. Lensner	Newark, N. J.
S. C. Leyland	Newark, N. J.
Samuel Lubin	North Adams, Mass.
L. E. Ludekens	Los Angeles, Calif.
J. D. Moynihan	East Pittsburgh, Pa.

Methods of Measurements and High Frequency Characteristics of Power Equipment and Transmission Lines Subcommittee

J. D. Moynihan, *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

J. F. Atkinson	Washington, D. C.
R. W. Beckwith	Syracuse, N. Y.
P. R. Crooker	Syracuse, N. Y.
R. J. Kavazia	
E. S. Kocsan	Johnstown, Pa.
N. M. Levinson	North Adams, Mass.
Samuel Lubin	North Adams, Mass.
L. R. Preston	Chicago, Ill.
B. J. Sparlin	Pittsburgh, Pa.

Use of Microwave Equipment for Relaying, Telemetering and Supervisory Control Subcommittee

T. A. Cramer, *Chairman;* General Electric Co., Electric Utility Engg. Dept., Schenectady 5, N. Y.

(Personnel to be selected at a later date)

Prepare a Carrier Current Bibliography Subcommittee

Samuel Lubin, *Chairman;* Sprague Electric Co., North Adams, Mass.

(Personnel to be selected at a later date)

Carrier Radiation Subcommittee

F. B. Gunter, *Chairman;* Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3, Md.

R. W. Beckwith	Syracuse, N. Y.
R. E. Lake	San Francisco, Calif.
L. E. Ludekens	Alhambra, Calif.
S. C. Preston	
E. F. Timme	Portland, Oreg.
L. G. Walker	Chicago, Ill.
Forrest Woodland, Jr.	New York, N. Y.

Committee on Insulated Conductors

M. H. McGrath, *Chairman;* General Cable Corp., 26 Washington St., Perth Amboy, N. J.

M. W. Ghen, *Vice-Chairman*	Pittsburgh, Pa.
L. E. Fogg, *Secretary*	Phillipsdale, R. I.
M. J. Andrews	Los Angeles, Calif.
R. W. Atkinson	Bayonne, N. J.
C. F. Avila	Boston, Mass.
C. E. Baugh	San Francisco, Calif.
E. D. Bent	Montreal, Que., Canada
C. E. Betzer	Chicago, Ill.
R. C. Blankenburg	Los Angeles, Calif.
Andrew Bodicky	St. Louis, Mo.
A. S. Brookes	Newark, N. J.
W. R. Bullard	New York, N. Y.
H. W. Clark	Washington, D. C.
E. W. Davis	Cambridge, Mass.
W. A. Del Mar	Yonkers, N. Y.
C. D. Eash	Jackson, Mich.
D. M. Farnham	Montreal, Que., Canada
G. H. Fiedler	Rochester, N. Y.
E. H. Finch	Chicago, Ill.
R. W. Gillette	New York, N. Y.
Herman Halperin	Chicago, Ill.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
H. T. Hofer	Denver, Colo.
L. E. Howard	Bridgeport, Conn.
B. R. Hubbard	Trenton, N. J.
R. H. Kolks	Cincinnati, Ohio
L. I. Komives	Detroit, Mich.
M. J. Lowenberg	Boston, Mass.
R. E. Morse	New York, N. Y.
J. H. Nicholas	Chicago, Ill.
C. T. Nicholson	Buffalo, N. Y.
J. C. Parker	Memphis, Tenn
W. T. Peirce	Worcester, Mass.
F. L. Phillips	Kansas City, Mo.
J. J. Pokorny	Cleveland, Ohio
S. J. Rosch	Hastings-on-Hudson, N. Y.
J. J. Rueckert	Baltimore, Md.
R. A. Schatzel	Rome, N. Y.
C. S. Schifreen	Philadelphia, Pa.
G. B. Shanklin	Schenectady, N. Y.
H. D. Short	Toronto, Ont., Canada
F. W. Smith	Richmond, Va.
Joseph Sticher	Detroit, Mich.
E. G. Sturdevant	Bristol, R. I.
Gordon Thompson	New York, N. Y.
R. J. Wiseman	Passaic, N. J.
K. S. Wyatt	Yonkers, N. Y.
C. W. Zimmerer	New York, N. Y.

Administration Subcommittee

M. H. McGrath, *Chairman;* General Cable Corporation, 26 Washington Street, Perth Amboy, N. J.

M. W. Ghen, *Vice-Chairman*	Pittsburgh, Pa.
L. E. Fogg, *Secretary*	Phillipsdale, R. I.

Subcommittee Chairmen:

A. S. Brookes	Newark, N. J.
E. W. Davis	Cambridge, Mass.
W. A. Del Mar	Yonkers, N. Y.
R. W. Gillette	New York, N. Y.
B. R. Hubbard	Trenton, N. J.
R. H. Kolks	Cincinnati, Ohio
L. I. Komives	Detroit, Mich.
W. T. Pierce	Worcester, Mass.
J. J. Pokorny	Cleveland, Ohio
S. J. Rosch	Hastings-on-Hudson, N. Y.
J. J. Rueckert	Baltimore, Md.
Joseph Sticher	Detroit, Mich.

Standards and Publication Subcommittee

A. S. Brookes, *Chairman;* Public Service Electric & Gas Co., 80 Park Place, Newark, N. J.

E. D. Bent	Montreal, Que., Canada
Andrew Bodicky	St. Louis, Mo.
L. E. Fogg	Phillipsdale, R. I.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
F. M. Hull	Detroit, Mich.
M. H. McGrath	Perth Amboy, N. J.
C. C. Shackford	Trenton, N. J.
C. W. Zimmerer	New York, N. Y.

Cable Characteristics Subcommittee

W. A. Del Mar, *Chairman;* Phelps Dodge Copper Products Co., Habirshaw Cable and Wire Division, Yonkers, N. Y.

M. J. Andrews	Los Angeles, Calif.
R. W. Atkinson	Westfield, N. J.
E. D. Bent	Montreal, Que., Canada
F. H. Buller	Schenectady, N. Y.
R. W. Burrell	New York, N. Y.
E. H. Finch	Chicago, Ill.
H. T. Hofer	Denver, Colo.
L. E. Howard	Bridgeport, Conn.
F. M. Hull	Detroit, Mich.
A. H. Kidder	Philadelphia, Pa.
M. H. McGrath	Perth Amboy, N. J.
Louis Meyerhoff	Bayonne, N. J.
J. H. Neher	Philadelphia, Pa.
F. L. Phillips	Kansas City, Mo.
G. B. Shanklin	Schenectady, N. Y.
R. J. Wiseman	Passaic, N. J.
F. O. Wollaston	Vancouver, B. C., Canada

Conductors Subcommittee

B. R. Hubbard, *Chairman;* J. A. Roebling's Sons Co., Trenton 2, N. J.

E. W. Greenfield	Spokane, Wash.

Insulations Subcommittee

Joseph Sticher, *Chairman;* The Detroit Edison Co., 2000—2nd Avenue, Detroit 26, Mich.

R. W. Atkinson	Westfield, N. J.
J. C. Balsbaugh	Cambridge, Mass.
J. T. Blake	Cambridge, Mass.
A. S. Dana	Seymour, Conn.
G. S. Eager, Jr.	Bayonne, N. J.
B. R. Hubbard	Trenton, N. J.
E. L. Lotz	Irvington, N. J.
E. E. McIlveen	Passaic, N. J.
R. B. McKinley	Bridgeport, Conn.
H. S. Moore	New Haven, Conn.
P. P. Murawski	New York, N. Y.
S. J. Rosch	Hastings-on-Hudson, N. Y.
E. S. Ross	Philadelphia, Pa.
R. A. Schatzel	Rome, N. Y.
G. M. L. Sommerman	Columbus, Ohio
E. G. Sturdevant	Bristol, R. I.
K. S. Wyatt	Yonkers, N. Y.

Sheaths and Coverings Subcommittee

J. J. Rueckert, *Chairman;* Consolidated Gas Electric Light & Power Co. of Baltimore, Monument & Constitution Streets, Baltimore 3, Md.

C. F. Avila	Boston, Mass.
C. F. Betzer	Chicago, Ill.
Andrew Bodicky	St. Louis, Mo.
A. S. Brookes	Newark, N. J.
G. E. Fiedler	Rochester, N. Y.
L. E. Fogg	Phillipsdale, R. I.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
F. M. Hull	Detroit, Mich.
A. H. Kidder	Philadelphia, Pa.
R. J. Mather	Portland, Oreg.
Louis Meyerhoff	Bayonne, N. J.
P. P. Murawski	New York, N. Y.
E. J. Nelson	Rochester, N. Y.
J. J. O'Donnell	New York, N. Y.
Samuel Rosenbach	Pittsburgh, Pa.
C. S. Schifreen	Philadelphia, Pa.
C. C. Schackford	Trenton, N. J.
H. D. Short	Toronto, Ont., Canada
R. C. Waldron	Passaic, N. J.
F. O. Wollaston	Vancouver, B. C., Canada
G. W. Zink	Yonkers, N. Y.

Cable Supply Systems Subcommittee

R. W. Gillette, *Chairman;* Consolidated Edison Company of New York, Inc., 4 Irving Place, New York 3, N. Y.

C. F. Avila	Boston, Mass.
P. L. Bellaschi	Portland, Oreg.
R. C. Blankenburg	Los Angeles, Calif.
F. A. Bolien	Portland, Oreg.
W. R. Bullard	New York, N. Y.
H. W. Clark	Washington, D. C.
D. M. Farnham	Montreal, Que., Canada
M. W. Ghen	Pittsburgh, Pa.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
H. T. Hofer	Denver, Colorado
L. W. Howard	Bridgeport, Conn.
H. Hyde	Toronto, Ont., Canada
L. I. Komives	Detroit, Mich.
M. J. Lowenberg	Boston, Mass.
R. J. Mather	Portland, Oreg.
M. H. McGrath	Perth Amboy, N. J.
C. T. Nicholson	Buffalo, N. Y.
J. C. Parker	Memphis, Tenn.
C. S. Schifreen	Philadelphia, Pa.
F. B. Shullerts	San Francisco, Calif.
G. B. Shanklin	Schenectady, N. Y.
H. D. Short	Tortono, Ont., Canada
F. W. Smith	Richmond, Va.
R. J. Wiseman	Passaic, N. J.
K. S. Wyatt	Yonkers, N. Y.

Utilization Wiring Systems Subcommittee

S. J. Rosch, *Chairman;* Anaconda Wire & Cable Co., Hastings-on-Hudson 6, N. Y.

W. R. Bullard	New York, N. Y.
E. C. DeBaene	Detroit, Mich.
H. P. Dupre	New York, N. Y.
G. S. Eager, Jr.	Bayonne, N. J.
R. W. Foster	Canton, N. C.
M. J. Lowenberg	Boston, Mass.
E. E. McIlveen	Passaic, N. J.
R. A. Schatzel	Rome, N. Y.
J. J. Tesoriero	New York, N. Y.
J. S. Waddington	Brockville, Ont., Canada
H. H. Watson	Bridgeport, Conn.
C. W. Zimmerer	New York, N. Y.

Special-Purpose Cable Subcommittee

W. T. Pierce, *Chairman;* American Steel and Wire Company, Worcester, Mass.

J. F. Atkinson	Washington, D. C.
E. D. Bent	Montreal, Que., Canada
H. W. Biskeborn	Ansonia, Conn.
E. W. Davis	Cambridge, Mass.
H. S. Eubank	New York, N. Y.
E. H. Finch	Chicago, Ill.
R. G. Gleeson	Jewett City, Conn.
R. H. Kolks	Cincinnati, Ohio
R. B. McKinley	Bridgeport, Conn.
F. L. Phillips	Kansas City, Mo.
E. G. Sturdevant	Bristol, R. I.
J. J. Tesoriero	New York, N. Y.
J. S. Waddington	Brockville, Ont., Canada
R. C. Waldron	Passaic, N. J.
A. J. Warner	Nutley, N. J.
G. W. Zink	Yonkers, N. Y.

Accessories Subcommittee

R. H. Kolks, *Chairman;* Cincinnati Gas & Electric Co., 323 Plum Street, Cincinnati 2, Ohio

C. D. Eash	Jackson, Mich.
R. W. Gillette	New York, N. Y.
R. C. Graham	Rome, N. Y.
E. W. Greenfield	Spokane, Wash.
E. H. Grosser	Chicago, Ill.
Fred Heller	New York, N. Y.
J. E. Johnson	Philadelphia, Pa.
E. L. Leinbach	Detroit, Mich.
H. E. Martin	Brooklyn, N. Y.
A. L. McKean	Yonkers, N. Y.
R. E. Morse	New York, N. Y.
J. H. Nicholas	Chicago, Ill.
J. J. Pokorny	Cleveland, Ohio
S. J. Rosch	Hastings-on-Hudson, N. Y.
Samuel Rosenbach	Pittsburgh, Pa.
F. B. Schullerts	San Francisco, Calif.
D. S. Young	Toronto, Ont., Canada

Structures Subcommittee

J. J. Pokorny, *Chairman;* Cleveland Electric Illuminating Co., 75 Public Square, Cleveland 1, Ohio

M. J. Andrews	Los Angeles, Calif.
C. E. Baugh	San Francisco, Calif.
R. C. Blankenburg	Los Angeles, Calif.
Andrew Bodicky	St. Louis, Mo.
H. W. Clark	Washington, D. C.
C. D. Eash	Jackson, Mich.
H. S. Eubank	New York, N. Y.
G. H. Fiedler	Rochester, N. Y.
M. W. Ghen	Pittsburgh, Pa.
R. W. Gillette	New York, N. Y.
H. Hyde	Toronto, Ontario, Canada
C. T. Nicholson	Bufflao, N. Y.
F. L. Phillips	Kansas City, Mo.
J. J. Rueckert	Baltimore, Md.
F. W. Smith	Richmond, Va.

Tests and Measurements Subcommittee

E. W. Davis, *Chairman;* Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

J. G. Balsbaugh	Cambridge, Mass.
P. L. Bellaschi	Portland, Oreg.
C. F. Betzer	Chicago, Ill.
A. S. Dana	Seymour, Conn.
W. A. Del Mar	Yonkers, N. Y.
C. G. Mansfield	Los Angeles, Calif.
J. C. Parker	Memphis, Tenn.
G. M. L. Sommerman	Columbus, Ohio
Joseph Sticher	Detroit, Mich.
Gordon Thompson	New York, N. Y.
P. H. Ware	Cambridge, Mass.
C. W. Zimmerer	New York, N. Y.

European Practice Subcommittee

L. I. Komives, *Chairman;* The Detroit Edison Company, 2000—2nd Avenue, Detroit 26, Mich.

A. N. Armand	Eastleigh, England
C. C. Barnes	London, England
Amund Braaten	Oslo, Norway
L. G. Brazier	London, England
W. R. Bullard	New York, N. Y., U.S.A.
E. L. Davey	Manchester, England
P. L. Dellis	Brussels, Belgium
L. Domenach	Lyon, France
Luigi Emanueli	Milan, Italy
W. Glass	London, England
Robert Goldschmidt	Cossonaz Gare, Switzerland
B. O. N. Hansson	Stockholm, Sweden
P. M. Hollingsworth	London, England
Heinz Horn	Koln Mulheim, Germany
M. E. Laborde	Paris, France
R. Laroche	Clichy, France
J. S. Mollerhoj	Copenhagen, Denmark
P. Muller	Brugg, Switzerland
Robert Nordell	Sundyberg, Sweden
C. T. W. Sutton	London, England
J. C. Van Staveren	Arnhem, Netherlands
A. J. Warner	London, England
R. J. Wiseman	Passaic, N. J., U.S.A.
K. S. Wyatt	Yonkers, N. Y., U.S.A.

Committee on Power Generation

J. B. McClure, *Chairman;* General Electric Co., Electric Utility Engineering, Schenectady, N. Y.

F. L. Lawton, *Vice-Chairman*	Montreal, Que., Canada
J. E. Barkle, Jr., *Secretary*	East Pittsburgh, Pa.
H. F. Abbott	Montreal, Que., Canada
C. E. Asbury	Jackson, Mich.
A. F. Ayres	Riverside, Calif.
W. C. Beattie	New York, N. Y.
E. P. Bryant	Los Angeles, Calif.
Giuseppe Calabrese	New York, N. Y.
W. J. Campbell	Detroit, Mich.
H. E. Deardorff	Dayton, Ohio
P. L. Dellis	Bruxelles, Belgium
S. M. Denton	Denver, Colo.
D. P. Dinapoli	San Francisco, Calif.
R. E. Dyer	Abernathy, Texas
V. F. Estcourt	San Francisco, Calif.
C. C. Farrell	Philadelphia, Pa.
G. P. Gamble	St. Louis, Mo.
C. H. Giroux	Washington, D. C.
R. M. Goar	Kansas City, Mo.
G. E. Grosser	Philadelphia, Pa.
W. P. Hammond	Atlanta, Ga.
C. E. Harris	Nashville, Tenn.
H. R. Harris	Detroit, Mich.

A. C. Hartranft	Philadelphia, Pa.
R. A. H. Hayes	Niagara Falls, Ont., Canada
A. P. Hayward	Pittsburgh, Pa.
J. A. Hooper	Portland, Oreg.
G. W. Kerr	Walla Walla, Wash.
C. E. Kilbourne	Schenectady, N. Y.
L. A. Kilgore	East Pittsburgh, Pa.
J. H. Kinghorn	New York, N. Y.
W. A. LaPierre	New York, N. Y.
J. T. Madill	Kitimat, B. C., Canada
G. H. McDaniel	New York, N. Y.
A. H. Mergenthaler	Birmingham, Ala.
E. G. Norell	Chicago, Ill.
C. F. Paulus	Cleveland, Ohio
A. L. Pollard	Seattle, Wash.
C. S. Randall	Washington, D. C.
T. D. Reimers	New York, N. Y.
L. M. Robertson	Denver, Colo.
L. T. Rosenberg	Milwaukee, Wis.
G. E. Schmitt	Austin, Texas
R. C. Schuknecht	Portland, Oreg.
J. M. Sharpe	Montreal, Que., Canada
B. G. A. Skortzki	New York, N. Y.
W. E. Taylor	Toronto, Ont., Canada
A. W. Walton	Oklahoma City, Okla.
Mead Warren, Jr.	Alcoa, Tenn.
B. A. Weiss	Imperial, Calif.
C. C. Whelchel	San Francisco, Calif.
R. R. Wisner	Boston, Mass.
G. R. Woodman	Los Angeles, Calif.

Prime Movers Subcommittee

B. G. A. Skrotzki, *Chairman;*	Associate Editor, *Power*, 330 West 42d St., New York 36, N. Y.
W. C. Beattie	New York, N. Y.
E. P. Bryant	Los Angeles, Calif.
W. P. Hammond	Atlanta, Ga.
A. P. Hayward	Pittsburgh, Pa.
J. T. Madill	Montreal, Que., Canada
A. L. Pollard	Seattle, Wash.
C. C. Whelchel, Jr.	San Francisco, Calif.

Station Design Subcommittee

J. E. Barkle, Jr., *Chairman;*	Westinghouse Electric Corp., Industry Engineering Dept., East Pittsburgh, Pa.
C. E. Asbury	Jackson, Mich.
H. C. Austin	Los Angeles, Calif.
H. E. Deardorff	Dayton, Ohio
P. L. Dellis	Bruxelles, Belgium
H. R. Harris	Detroit, Mich.
A. G. Mellor	Schenectady, N. Y.
A. H. Mergenthaler	Birmingham, Ala.
C. F. Paulus	Cleveland, Ohio
W. W. Perry	Binghamton, N. Y.
A. H. Philips	Reading, Pa.
R. R. Wisner	Boston, Mass.

Excitation Systems Subcommittee

J. H. Kinghorn, *Chairman;*	American Gas & Electric Service Corp., 30 Church Street, New York, N. Y.
T. J. Bliss	East Pittsburgh, Pa.
H. W. Cory	Milwaukee, Wis.
P. L. Dandeno	Toronto, Ont., Canada
S. M. Denton	Denver, Colo.
M. S. Kirwin	Jackson, Mich.
L. F. Lischer	Chicago, Ill.
E. W. Taylor	Allentown, Pa.
Michael Temoshok	Schenectady, N. Y.
C. E. Valentine	East Pittsburgh, Pa.

Hydro-Electric Systems Subcommittee

F. L. Lawton, *Chairman;*	Aluminum Laboratories, Ltd., 1800 Sun Life Building, Montreal, Que., Canada
H. F. Abbott	Montreal, Que., Canada
S. M. Denton	Denver, Colo.
J. P. Fraser	Vancouver, B. C., Canada
C. H. Giroux	Washington, D. C.
R. A. Hopkins	Knoxville, Tenn.
A. W. Howard	Calgary, Alta., Canada
A. L. Pollard	Seattle, Washington
L. M. Robertson	Denver, Colo.
J. M. Sharpe	Montreal, Que., Canada
T. C. Stavert	Los Angeles, Calif.
W. E. Taylor	Toronto, Ont., Canada
Mead Warren, Jr.	Alcoa, Tenn.
E. C. Whitney	East Pittsburgh, Pa.
C. R. Woodman	Los Angeles, Calif.

Pacific Coast Subcommittee

E. P. Bryant, *Chairman;*	Dept. of Water & Power, City of Los Angeles, 1677 Hill Drive, Los Angeles, Calif.
S. M. Denton	Denver, Colo.
Alex Dovjikov	Portland, Oreg.
V. H. Estcourt	San Francisco, Calif.
N. G. Holmdahl	Coulee Dam, Wash.
Thomas Ingledow	Vancouver, B. C., Canada
J. V. Kresser	San Francisco, Calif.
A. L. Pollard	Seattle, Wash.
G. R. Woodman	Los Angeles, Calif.

Speed Governing Subcommittee

G. H. McDaniel, *Chairman;*	American Gas & Elec. Service Corp., 30 Church Street, New York 8, N. Y.
H. F. Abbott	Montreal, Que., Canada
C. P. Almon, Jr.	Chattanooga, Tenn.
C. L. Avery	Rockford, Ill.
J. M. Baker	Lynn, Mass.
A. P. Hayward	Pittsburgh, Pa.
W. D. Marsh	Schenectady, N. Y.
T. H. Mawson	Birmingham, Ala.
F. L. Reinmann	Michigan City, Ind.
D. M. Sauter	East Pittsburgh, Pa.
G. J. Vencill	St. Louis, Mo.

Committee on Protective Devices

E. G. Norell, *Chairman;*	Sargent & Lundy, 140 South Dearborn St., Chicago 3, Ill.
E. M. Hunter, *Vice-Chairman*	Schenectady, N. Y.
K. H. Kidd, *Secretary*	Toronto, Ont., Canada
G. G. Auer	Schenectady, N. Y.
J. P. B[illegible]rron	Dallas, Texas
T. L. Berri	Denver, Colo.
G. D. Breuer	Schenectady, N. Y.
S. E. Caldwell	Portland, Oreg.
P. S. Colby	Raleigh, N. C.
J. O. Coleman	Boston, Mass.
L. M. Connors	Toronto, Ont., Canada
H. A. Cornelius	Chicago, Ill.
J. M. Crawford	Montreal, Que., Canada
F. M. Defandorf	Washington, D. C.
G. K. Ditlow	Washington, D. C.
G. B. Dodds	Pittsburgh, Pa.
J. R. Eaton	West Lafayette, Ind.
T. I. Eldridge	Philadelphia, Pa.
Byron Evans	Denver, Colo.
R. D. Hambrick	San Francisco, Calif.
P. A. Jeanne	New York, N. Y.
W. A. Lewis, Jr.	Chicago, Ill.
G. F. Lincks	Pittsfield, Mass.
F. R. Longley	Springfield, Mass.
R. E. Neidig	Reading, Pa.
A. M. Opsahl	East Pittsburgh, Pa.
H. L. Rorden	New York, N. Y.
P. W. Shill	Niagara Falls, Ont., Canada
W. E. Shula	Fort Worth, Texas
O. L. Sidenfaden	Los Angeles, Calif.
H. O. Stoelting	South Milwaukee, Wis.
D. C. Switzer	Hartford, Conn.
H. R. Tomlinson	Boston, Mass.
J. M. Towner	Baltimore, Md.
C. L. Wagner	East Pittsburgh, Pa.
E. H. Yonkers	Chicago, Ill.

Lightning Protective Devices Subcommittee

A. M. Opsahl, *Chairman;*	Westinghouse Electric Corporation, Switchgear Distribution Apparatus, East Pittsburgh, Pa.
H. R. Armstrong	Detroit, Michigan
S. E. Caldwell	Portland, Oreg.
L. M. Connors	Toronto, Ont., Canada
H. A. Cornelius	Chicago, Ill.
F. M. Defandorf	Washington, D. C.
G. K. Ditlow	Washington, D. C.
J. R. Eaton	Lafayette, Ind.
T. I. Eldridge	Philadelphia, Pa.
W. F. Griffard	Jackson, Mich.
I. W. Gross	New York, N. Y.
S. B. Howard	Pittsfield, Mass.
R. F. Huber	Chicago, Ill.
L. S. Inskip	Murray Hill, N. J.
I. B. Johnson	Schenectady, N. Y.
J. W. Kalb	Barberton, Ohio
D. K. Mann	Pittsburgh, Pa.
H. O. Stoelting	S. Milwaukee, Wis.
J. M. Towner	Baltimore, Md.
C. L. Wagner	East Pittsburgh, Pa.

Co-ordination of Insulation Subcommittee

J. M. Towner, *Chairman;* Consolidated Gas Electric Light & Power Co. of Baltimore, Baltimore 3, Md.

Fault Limiting Devices Subcommittee

J. O. Coleman, *Chairman;*	Stone & Webster Engg. Corp., 49 Federal St., Boston 7, Mass.
C. F. Bishop	Philadelphia, Pa.
G. D. Breuer	Schenectady, N. Y.
G. B. Dodds	Pittsburgh, Pa.
Byron Evans	Denver, Colo.
W. H. Ferguson	East Pittsburgh, Pa.
Eugene M. Hunter	Schenectady, N. Y.
Paul A. Jeanne	New York, N. Y.
Charles C. Jones	Birmingham, Ala.
W. A. Lewis, Jr.	Chicago, Ill.
F. R. Longley	Springfield, Mass.
W. W. Loucks	Toronto, Ont., Canada
Corbett McLean	Portland, Oreg.
Elmer G. Norell	Chicago, Ill.
John C. Russ	Pittsfield, Mass.
Louis E. Sauer	Sharon, Pa.
Oscar L. Sidenfanden	Los Angeles, Calif.
Donald C. Switzer	Hartford, Conn.

Committee on Relays

Frank von Roeschlaub, *Chairman;*	Ebasco Services, Inc., 2 Rector St., New York 6, N. Y.
W. K. Sonnemann, *Vice-Chairman*	Newark, N. J.
G. W. McKenna, *Secretary*	Philadelphia, Pa.
A. W. Adams	Portland, Oreg.
J. E. Barkle, Jr.	East Pittsburgh, Pa.
H. C. Barnes	New York, N. Y.
J. L. Blackburn	Newark, N. J.
M. A. Bostwick	Portland, Oreg.
J. W. Bowman	Fort Wayne, Ind.
L. L. Brandow	Binghamton, N. Y.
F. P. Brightman	Schenectady, N. Y.
R. J. Cooper	Atlanta, Ga.
R. E. Cordray	Philadelphia, Pa.
M. A. Faucett	Decatur, Ill.
F. S. Fehr	Reading, Pa.
L. F. Ferri	Jackson, Mich.
L. L. Fountain	East Pittsburgh, Pa.
M. M. Gilbert	Wilmington, Del.
Sidney Goldsmith	Cincinnati, Ohio
T. R. Halman	Detroit, Mich.
G. W. Hampe	Chicago, Ill.
C. E. Harris	Charlotte, N. C.
V. J. Hayes	Hartford, Conn.
C. L. Headley	Baltimore, Md.
R. W. Hirtler	Los Angeles, Calif.
R. O. Hopkins	Beaumont, Texas
R. A. Larner	Fort Worth, Texas
J. R. Linders	Cleveland, Ohio
Cort Lowerison	Los Angeles, Calif.
W. E. Marter	Pittsburgh, Pa.
A. J. McConnell	Schenectady, N. Y.
M. S. Merritt	Chattanooga, Tenn.
W. O. Montgomery	Plainfield, Ind.
C. S. Murray	New York, N. Y.
M. P. Osburn	Toronto, Ont., Canada
Arthur Scott	San Francisco, Calif.
H. P. Sleeper	Newark, N. J.
George Steeb	Buffalo, N. Y.
Victor Verrall	Springfield, Ill.
R. W. World	Denver, Colo.

Pacific Coast Subcommittee

M. A. Bostwick, *Chairman;*	Portland General Electric Co., 621 S. W. Alder St., Portland, Oreg.
Cort Lowerison, *Vice-Chairman*	Los Angeles, Calif.
A. W. Adams	Portland, Oreg.
W. G. Collins	San Francisco, Calif.
J. R. Curtin	Portland, Oreg.
L. L. Draper	Los Angeles, Calif.
A. E. Frey	Portland, Oreg.
G. B. Gilcrest	San Francisco, Calif.
W. G. Meyer	Portland, Oreg.
W. S. Moody	Los Angeles, Calif.
Ray Rader	Seattle, Wash.
J. W. Savage	Los Angeles, Calif.
Arthur Scott	San Francisco, Calif.
J. F. Sinnott	San Diego, Calif.
G. E. Smith	Portland, Oreg.
E. T. Vickerman, Jr.	Spokane, Wash.

Subcommittee on Bibliography of Relay Literature

M. A. Faucett, *Chairman;*	Illinois Power Co., 134 East Main St., Decatur, Illinois
H. G. Goers	Decatur, Ill.
Sidney Goldsmith	Cincinnati, Ohio
W. O. Montgomery	Plainfield, Ind.
C. L. Smith	Rochester, N. Y.
E. T. Vickerman, Jr.	Spokane, Wash.

Revision of Standards for Power Relays Project Committee

J. R. Linders, *Chairman & Sponsor;*	Cleveland Elec. Illuminating Co., 75 Public Square, Cleveland 1, Ohio
G. W. Hampe, *Vice-Chairman*	Chicago, Ill.
R. E. Cordray	Philadelphia, Pa.
L. L. Fountain	East Pittsburgh, Pa.

R. O. Hopkins	Beaumont, Texas
W. A. Lewis, Jr.	Chicago, Ill.
Arthur Scott	San Francisco, Calif.
H. P. Sleeper	Newark, N. J.
W. K. Sonnemann	Newark, N. J.
George Steeb	Buffalo, N. Y.
Frank von Roeschlaub	New York, N. Y.
R. W. World	Denver, Colo.

Project Committee on Transmission Line Protection

J. E. Barkle, Jr., *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

Frank von Roeschlaub, *Vice-Chairman*	New York, N. Y.
L. J. Audlin	Syracuse, N. Y.
J. W. Bowman	Fort Wayne, Ind.
V. J. Hayes	Waterbury, Conn.
W. A. Lewis, Jr.	Chicago, Ill.
W. E. Marter	Pittsburgh, Pa.
A. J. McConnell	Schenectady, N. Y.
M. S. Merritt	Chattanooga, Tenn.
W. O. Montgomery	Plainfield, Ind.
J. W. Savage	Los Angeles, Calif.
H. P. Sleeper	Newark, N. J.

Project Committee on Protection of Generators on Unbalanced Current

G. W. McKenna, *Chairman;* Philadelphia Electric Company, 1000 Chestnut Street, Philadelphia 5, Pa.

J. E. Barkle, Jr., *Vice-Chairman*	East Pittsburgh, Pa.
R. E. Cordray	Philadelphia, Pa.
W. E. Glassburn	Newark, N. J.
T. R. Halman	Detroit, Mich.
R. A. Larner	Fort Worth, Tex.
W. G. Meyer	San Francisco, Calif.
Frank von Roeschlaub	New York, N. Y.

Project Committee on Electronic Relay Applications

F. S. Fehr, *Chairman & Sponsor;* Metropolitan Edison Co., 412 Washington Street, Reading, Pa.

J. E. Barkle, Jr., *Vice-Chairman*	East Pittsburgh, Pa.
H. C. Barns	New York, N. Y.
R. J. Cooper	Atlanta, Ga.
L. F. Ferri	Jackson, Mich.
D. M. MacGregor	New York, N. Y.
M. P. Osburn	Toronto, Ont., Canada
R. I. Ward	Chicago, Ill.

Project Committee on Co-ordination of Relay Protection of Industrial Power Systoms With Utility Systems

T. R. Halman, *Chairman & Sponsor;* The Detroit Edison Co., 2000—2nd Ave., Detroit, Mich.

J. R. Linders, *Vice-Chairman*	Cleveland, Ohio
J. E. Barkle, Jr.	East Pittsburgh, Pa.
F. P. Brightman	Schenectady, N. Y.
F. S. Fehr	Reading, Pa.
L. F. Ferri	Jackson, Mich.
L. L. Fountain	East Pittsburgh, Pa.
M. M. Gilbert	Wilmington, Del.
G. W. Hampe	Chicago, Ill.
B. B. Kern	Hazleton, Pa.
S. W. Luther	Detroit, Mich.
G. W. McKenna	Philadelphia, Pa.
R. H. Rankin	Rochester, N. Y.
T. O. Sweatt	New York, N. Y.

Project Committee on Relaying Performance of Current Transformers

R. E. Cordray, *Chairman;* General Electric Co., 6901 Elmwood Ave., Philadelphia, Pa.

M. P. Osborn, *Vice-Chairman*	Toronto, Ont., Canada
J. E. Barkle, Jr.	East Pittsburgh, Pa.
J. W. Curtin	Portland, Oregon
F. R. D'Entremont	Lynn, Mass.
T. R. Halman	Detroit, Mich.
W. A. Lewis, Jr.	Chicago, Ill.
G. E. Smith	Portland, Oreg.
W. K. Sonnemann	Newark, N. J.
C. A. Woods	East Pittsburgh, Pa.

Project Committee on Effect of Vibration and Shock on Relays

L. F. Ferri, *Chairman;* Commonwealth Associates, Inc., 212 West Michigan Ave., Jackson, Mich.

A. W. Adams	Portland, Oreg.
R. E. Cordray	Philadelphia, Pa.
M. A. Faucett	Decatur, Ill.
T. R. Halman	Detroit, Mich.
H. F. Lindemuth	New York, N. Y.
W. K. Sonnemann	Newark, N. J.
G. S. Steeb	Buffalo, N. Y.

Project Committee on Test Methods

Sidney Goldsmith, *Chairman;* Cincinnati Gas & Elec. Co., 323 Plum Street, Cincinnati, Ohio

F. S. Fehr, *Vice-Chairman*	Reading, Pa.
R. E. Cordray	Philadelphia, Pa.
L. F. Ferri	Elyria, Ohio
T. R. Halman	Detroit, Mich.
J. E. Lange	Pittsburgh, Pa.
R. A. Larner	Fort Worth, Texas
W. F. Mackenzie	Hazleton, Pa.
C. S. Murray	New York, N. Y.
W. K. Sonnemann	Newark, N. J.
Harry St. Clair	Chattanooga, Tenn.

Project Committee on Pilot Wires

J. L. Blackburn, *Chairman;* Westinghouse Electric Corp., 95 Orange Street, Newark, N. J.

W. E. Marter, *Vice-Chairman*	Pittsburgh, Pa.
M. A. Bostwick	Portland, Oregon
L. L. Fountain	East Pittsburgh, Pa.
V. J. Hayes	Hartford, Conn.
H. H. Leech	Philadelphia, Pa.
A. J. McConnell	Schenectady, N. Y.
G. W. McKenna	Philadelphia, Pa.
C. S. Murray	New York, N. Y.
R. W. Ralston	New York, N. Y.
H. O. Saunders, Jr.	New York, N. Y.
E. J. Simmons	Mineola, N. Y.
Victor Verrall	Springfield, Ill.

Project Committee on Devices for Control of Load Shedding and System Separation

A. J. McConnell, *Chairman;* General Electric Company, 1 River Road, Schenectady, N. Y.

L. L. Brandow, *Vice-Chairman*	Binghamton, N. Y.
A. W. Adams	Portland, Oreg.
M. A. Bostwick	Portland, Oreg.
F. P. Brightman	Schenectady, N. Y.
M. D. Ewing	Atlantic City, N. J.
F. S. Fehr	Reading, Pa.
L. L. Fountain	East Pittsburgh, Pa.
R. A. Larner	Fort Worth, Texas
W. E. Marter	Pittsburgh, Pa.
H. P. Sleeper	Newark, N. J.
George Steeb	Buffalo, N. Y.
Frank von Roeschlaub	New York, N. Y.

Project Committee on Motor Protection

H. C. Barnes, *Chairman;* American Gas & Electric Service Corp., 30 Church Street, New York, N. Y.

L. F. Ferri	Jackson, Mich.
L. L. Fountain	East Pittsburgh, Pa.
M. M. Gilbert	Wilmington, Del.
V. J. Hayes	Waterbury, Conn.
H. F. Lindemuth	New York, N. Y.
Victor Verrall	Springfield, Ill.

Project Committee on Co-ordination of Construction and Protection of Distribution Circuits (Joint with Distribution Subcommittee and Edison Electric Institute)

G. B. Dodds, *AIEE Chairman & Sponsor;* Duquesne Light Company, 435 Sixth Avenue, Pittsburgh 19, Pa.

R. O. Askey	Chicago, Ill.
G. G. Auer	Schenectady, N. Y.
T. J. Brosnan	Buffalo, N. Y.
Harold Cole	Detroit, Mich.
C. L. Headley	Baltimore, Md.
H. F. Ostman	St. Louis, Mo.
C. L. Smith	Rochester, N. Y.

C. J. Beller, *EEI Chairman & Sponsor;* Cleveland Elec. Illuminating Co., 75 Public Square, Cleveland 1, Ohio

G. E. Dean	Newark, N. J.
G. H. Fiedler	Rochester, N. Y.
W. P. Holben	Pittsburgh, Pa.
A. L. Malmstrom	Detroit, Mich.

Committee on Rotating Machinery

E. I. Pollard, *Chairman;* Elliott Company, P. O. Drawer P, Ridgway, Pa.

M. L. Schmidt, *Vice-Chairman*	Fort Wayne, Ind.
R. F. Edwards, *Secretary*	Ridgway, Pa.
P. L. Alger	Schenectady, N. Y.
W. R. Appleman	Dayton, Ohio
R. E. Arnold	Lynn, Mass.
C. E. Asbury	Jackson, Mich.
M. A. Baker	Erie, Pa.
J. W. Batchelor	East Pittsburgh, Pa.
C. H. Bjorquist	Portland, Oreg.
L. W. Buchanan	Lima, Ohio
E. P. Codling	North Plainfield, N. J.
James DeKiep	Minneapolis, Minn.
L. O. Dorfman	New York, N. Y.
F. A. Eastom	Boulder, Colo.
R. W. Ferguson	East Pittsburgh, Pa.
W. H. Fifer	Washington, D. C.
L. T. Fisher	Portland, Oreg.
E. H. Fredrick	Kenosha, Wis.
R. W. Gaskins	St. Louis, Mo.
Lanier Greer	Cleveland, Ohio
L. N. Grier	Pittsburgh, Pa.
S. F. Henderson	Buffalo, N. Y.
J. W. Jones	Philadelphia, Pa.
C. E. Kilbourne	Schenectady, N. Y.
J. L. Kuehlthau	Milwaukee, Wis.
M. F. Leftwich	Charlotte, N. C.
I. M. Levy	Dayton, Ohio
W. A. Lewis	Chicago, Ill.
T. C. Lloyd	Springfield, Ohio
A. T. McClinton	Washington, D. C.
T. H. Morgan	Worcester, Mass.
R. F. Munier	St. Louis, Mo.
J. G. Noest	New York, N. Y.
L. C. Packer	Springfield, Mass.
F. M. Porter	New York, N. Y.
W. L. Ringland	West Allis, Wis.
F. C. Rushing	Buffalo, N. Y.
L. P. Shildneck	Lynn, Mass.
C. L. Sidway	Los Angeles, Calif.
H. R. Sills	Peterboro, Ont., Canada
L. F. Stauder	Notre Dame, Ind.
H. V. Street	Miami, Fla.
K. Y. Tang	Columbus, Ohio
F. R. Terrant	Cleveland, Ohio
P. H. Trickey	St. Louis, Mo.
J. J. Unger	Cleveland, Ohio
E. C. Whitney	East Pittsburgh, Pa.

Administrative Subcommittee

E. I. Pollard, *Chairman;* Eliott Co., Ridgway, Pa.

M. L. Schmidt, *Vice-Chairman*	Fort Wayne, Ind.
R. F. Edwards, *Secretary*	Ridgway, Pa.
L. W. Buchanan	Lima, Ohio
E. P. Codling	Cleveland, Ohio
L. O. Dorfman	New York, N. Y.
E. H. Fredrick	Kenosha, Wis.
A. T. McClinton	Washington, D. C.
J. G. Noest	New York, N. Y.
C. L. Sidway	Los Angeles, Calif.
F. R. Terrant	Cleveland, Ohio

Synchronous Machinery Subcommittee

L. O. Dorfman, *Chairman;* Ebasco Services, Inc., 2 Rector Street, New York 6, N. Y.

C. E. Asbury	Jackson, Mich.
J. W. Batchelor	East Pittsburgh, Pa.
C. H. Bjorquist	Portland, Oreg.
James DeKiep	Minneapolis, Minn.
L. J. Fisher	Portland, Oreg.
B. N. Gafford	Austin, Texas
R. W. Gaskins	St. Louis, Mo.
D. B. Harrington	Schenectady, N. Y.
J. W. Jones	Philadelphia, Pa.
C. E. Kilbourne	Schenectady, N. Y.
G. G. Law	Chicago, Ill.
W. A. Lewis, Jr.	Chicago, Ill.
M. R. Lory	East Pittsburgh, Pa.
J. G. Noest	New York, N. Y.
E. I. Pollard	Ridgway, Pa.
F. M. Porter	New York, N. Y.
W. L. Ringland	Milwaukee, Wis.
L. P. Shildneck	Lynn, Mass.
H. R. Sills	Peterboro, Ont., Canada
A. C. Sugden	Mineola, N. Y.
E. C. Whitney	East Pittsburgh, Pa.
J. Q. Wray	Baltimore, Md.

Induction Machinery Subcommittee

J. G. Noest, *Chairman;* Consolidated Edison Company of New York, Inc., 4 Irving Place, New York 3, N. Y.

P. L. Alger	Schenectady, N. Y.
E. C. Barnes	Cleveland, Ohio
J. H. Behm	Fort Wayne, Ind.
E. A. Eastom	Boulder, Colo.
J. F. Heidbreder	East Pittsburgh, Pa.
S. F. Henderson	Buffalo, N. Y.
J. J. Kirkish	Milwaukee, Wis.
C. J. Koch	Schenectady, N. Y.
Yu H. Ku	Philadelphia, Pa.
M. F. Leftwich	Charlotte, N. C.
I. M. Levy	Dayton, Ohio

T. C. Lloyd	Springfield, Ohio
H. B. Margolis	New York, N. Y.
W. D. Marsh	Schenectady, N. Y.
R. C. Moore	Milwaukee, Wis.
C. P. Potter	St. Louis, Mo.
Llewellyn Saunders	Norfolk, Va.
J. J. Sousa	Ampere, N. J.
P. H. Trickey	St. Louis, Mo.

D-C Machinery Subcommittee

A. T. McClinton, *Chairman;* Electricity Division, U.S. Naval Research Lab., Washington 20, D. C.

M. A. Baker	Fort Wayne, Ind.
J. A. Clark	Cleveland, Ohio
C. F. Cobb	Norwood, Ohio
W. H. Fifer	Washington, D. C.
Lanier Greer	Cleveland, Ohio
L. N. Grier	Pittsburgh, Pa.
C. B. Hathaway	Buffalo, N. Y.
L. H. Hirsch	St. Louis, Mo.
H. E. Koenig	Urbana, Ill.
Richard Lamborn	Erie, Pa.
Paul Lebenbaum, Jr.	Lynn, Mass.
T. J. Martin	Seattle, Wash.
T. H. Morgan	Worcester, Mass.
E. H. Myers	East Pittsburgh, Pa.
D. S. Pearson	State College, Pa.
W. J. Price	New York, N. Y.
J. H. Schneider	Ridgway, Pa.
E. P. Smith	Schenectady, N. Y.
J. J. Unger	Cleveland, Ohio
C. O. Weilbaecher	Milwaukee, Wis.

Single Phase and Fractional Horsepower Subcommittee

E. P. Codling, *Chairman;* Jack & Heintz, Inc., Cleveland 1, Ohio

W. R. Appleman	Dayton, Ohio
N. Bratu	Chicago, Ill.
C. F. Cameron	Stillwater, Okla.
L. H. Hirsch	St. Louis, Mo.
J. H. Karr	Springfield, Ohio
E. E. Kimberly	Columbus, Ohio
I. M. Levy	Dayton, Ohio
C. F. Miller	Baltimore, Md.
R. F. Munier	St. Louis, Mo.
L. C. Packer	Springfield, Mass.
C. P. Potter	St. Louis, Mo.
L. C. Schaefer	Lima, Ohio
F. W. Suhr	Fort Wayne, Ind.
K. Y. Tang	Columbus, Ohio
C. G. Veinott	Cleveland, Ohio
J. E. Williams	Urbana, Ill.

Test Code Subcommittee

L. W. Buchanan, *Chairman;* Westinghouse Electric Corp., Lima, Ohio

R. E. Arnold	Lynn, Mass.
T. E. M. Carville	Lima, Ohio
C. E. Kilbourne	Schenectady, N. Y.
E. E. Kimberly	Columbus, Ohio
G. L. Moses	East Pittsburgh, Pa.
E. B. Paxton	Schenectady, N. Y.
E. P. Smith	Schenectady, N. Y.
F. R. Terrant	Cleveland, Ohio

Insulation Subcommittee

C. L. Sidway, *Chairman;* Southern California Edison Co., Edison Building, Los Angeles, Calif.

P. L. Alger	Schenectady, N. Y.
J. S. Askey	Ridgway, Pa.
L. J. Berberich	East Pittsburgh, Pa.
A. W. W. Cameron	Toronto, Ont., Canada
L. M. Conklin	Ashton, R. I.
E. B. Curdts	Philadelphia, Pa.
J. F. Dexter	Midland, Mich.
P. A. Emmons	Badin, N. C.
W. T. Gordon	Lima, Ohio
Lanier Greer	Cleveland, Ohio
P. W. Hernick	Minneapolis, Minn.
G. L. Hill	Emeryville, Calif.
J. W. Jones	Philadelphia, Pa.
M. S. Kirwen	Jackson, Mich.
J. L. Kuehlthau	Milwaukee, Wis.
H. C. Marcroft	Lancaster, Pa.
G. L. Moses	East Pittsburgh, Pa.
E. H. Povey	Belmont, Mass.
Ernst Schmitt	Chicago, Ill.
J. B. Swering	Hartford, Conn.
H. R. Tomlinson	Boston, Mass.
E. H. Tovee	Hamilton, Ont., Canada
A. L. Van Emden	Washington, D. C.
R. W. Wieseman	Schenectady, N. Y.

Electric Coupling Subcommittee

E. H. Fredrick, *Chairman;* Dynamatic Corp., 3307 Fourteenth Street, Kenosha, Wis.

W. J. Cherones	Milwaukee, Wis.
J. H. Coolidge	Chicago, Ill.
James DeKiep	Minneapolis, Minn.
R. F. Edwards	Ridgway, Pa.
Paul Harter	Beloit, Wis.
R. L. Jaeschke	Kenosha, Wis.
M. R. Lory	East Pittsburgh, Pa.
J. A. Mason	Worcester, Mass.
R. E. Seddon	Wilmington, Del.
L. F. Stauder	Notre Dame, Ind.
P. H. Trickey	St. Louis, Mo.

Bibliography and Publicity Subcommittee

M. L. Schmidt, *Chairman;* General Electric Co., Fort Wayne, Ind.

J. H. Behm	Fort Wayne, Ind.
R. J. Farrell	Cleveland, Ohio
W. R. Goss	Fort Wayne, Ind.
M. R. Lory	East Pittsburgh, Pa.
G. L. Moses	East Pittsburgh, Pa.
J. H. Schneider	Ridgway, Pa.
P. H. Trickey	St. Louis, Mo.

Committee on Substations

I. S. Mendenhall, *Chairman;* The Detroit Edison Co., 2000 Second Avenue, Detroit 26, Mich.

W. S. Scheering, *Vice-Chairman*	Springfield, Mass.
J. A. Smith, *Secretary*	Schenectady, N. Y.
Herman Bany	Philadelphia, Pa.
Harris Barber	Boston, Mass.
H. F. Barsun	Sharon, Pa.
J. F. Bracken	Chicago, Ill.
R. L. Brown	Sharon, Pa.
J. L. Buckley	San Francisco, Calif.
H. P. Cadario	Toronto, Ont., Canada
F. J. Chapin	Syracuse, N. Y.
W. A. Clark	New York, N. Y.
P. S. Colby	Raleigh, N. C.
A. B. Covey	New York, N. Y.
C. C. Crane	Madison, Wis.
J. C. Davis	Kansas City, Mo.
J. R. Dickey	Corpus Christi, Texas
J. W. Erven	Los Angeles, Calif.
C. S. Fiske	Baltimore, Md.
W. H. Fong	Montreal, Que., Canada
R. F. Gibbons	Santa Clara, Calif.
H. F. Gidlund	Denver, Colo.
P. G. Gilbert	Philadelphia, Pa.
G. F. Gleason	Rochester, N. Y.
R. R. Godard	Uniontown, Pa.
W. K. Harding	Charlotte, N. C.
P. F. Hargreaves	Seattle, Wash.
C. I. Hendricks	Fort Worth, Texas
E. M. Hunter	Schenectady, N. Y.
T. M. Hunter	Washington, D. C.
S. C. Killian	Chicago, Ill.
W. M. Larson	Minneapolis, Minn.
R. F. Lawrence	East Pittsburgh, Pa.
F. W. Linder	La Crosse, Wis.
F. J. Maas	Portland, Oreg.
H. H. Marsh, Jr.	Pittsburgh, Pa.
R. K. Moore	Scranton, Pa.
P. R. Pierson	East Pittsburgh, Pa.
A. H. Powell	Philadelphia, Pa.
M. E. Reagan	East Pittsburgh, Pa.
J. H. Rixse, Jr.	Washington, D. C.
O. J. Rotty	St. Louis, Mo.
D. S. Sandlin	Freeport, Texas
J. W. Savage	Los Angeles, Calif.
A. F. Sedgwick	New Haven, Conn.
P. W. Shill	Niagara Falls, Ont., Canada
H. G. Silliman	Seattle, Wash.
J. E. Smith	Dayton, Ohio
C. H. Smoke	Norfolk, Va.
P. R. Spracher	Richmond, Va.
R. F. Stevens	Portland, Oreg.
D. W. Taylor	Newark, N. J.
D. W. Webb	Milwaukee, Wis.
K. L. Wheeler	Cleveland, Ohio
E. A. Williams, Jr.	Greensburg, Pa.
C. H. Youngdahl	Chicago, Ill.

Executive Subcommittee

W. S. Scheering, *Chairman;* Western Massachusetts Electric Co., 73 State Street, Springfield 9, Mass.

I. S. Mendenhall, *Vice-Chairman*	Detroit, Mich.
J. A. Smith, *Secretary*	Schenectady, N. Y.
Herman Bany	Philadelphia, Pa.
R. F. Gibbons	Santa Clara, Calif.
E. M. Hunter	Schenectady, N. Y.
H. H. Marsh, Jr.	Pittsburgh, Pa.
M. E. Reagan	East Pittsburgh, Pa.
O. J. Rotty	St. Louis, Mo.
R. F. Stevens	Portland, Oreg.

Transmission Substation Subcommittee

R. F. Stevens, *Chairman;* Bonneville Power Administration, Portland, Oreg.

Harris Barber	Boston, Mass.
J. L. Buckley	San Francisco, Calif.
H. P. Cadario	Toronto, Ont., Canada
R. F. Gibbons	Santa Clara, Calif.
H. F. Gidlund	Denver, Colo.
E. M. Hunter	Schenectady, N. Y.
S. C. Killian	Chicago, Ill.
F. W. Linder	La Crosse, Wis.
J. H. Rixse, Jr.	Washington, D. C.
W. S. Scheering	Springfield, Mass.
D. W. Taylor	Newark, N. J.

Working Group on Project 53.1 Extra High Voltage Substations

R. F. Gibbons, *Chairman;* Pacific Electric Mfg. Corp., 333 Brokan Road, Santa Clara, Calif.

W. H. Fong	Montreal, Que., Canada
S. C. Killian	Chicago, Ill.
W. S. Scheering	Springfield, Mass.
J. A. Smith	Schenectady, N. Y.
R. F. Stevens	Portland, Oreg.
D. W. Taylor	Newark, N. J.
C. P. Zimmerman	New York, N. Y.

Distribution Substation Subcommittee

O. J. Rotty, *Chairman;* Union Electric Company of Missouri, 315 North 12th Blvd., St. Louis 1, Mo.

Herman Bany	Philadelphia, Pa.
H. F. Barsun	Sharon, Pa.
H. J. Chambers	Toronto, Ont., Canada
F. J. Chapin	Syracuse, N. Y.
C. C. Crane	Madison Wis.
J. W. Erven	Los Angeles, Calif.
E. M. Hunter	Schenectady, N. Y.
F. W. Linder	La Crosse, Wis.
P. R. Pierson	East Pittsburgh, Pa.
W. S. Scheering	Springfield, Mass.
R. F. Stevens	Portland, Oreg.

Working Group on Project 20—Standardization of Factory-Design Substations

E. M. Hunter, *Chairman;* General Electric Co., Schenectady, N. Y.

P. R. Pierson	East Pittsburgh, Pa.
W. S. Scheering	Springfield, Mass.
D. W. Webb	Milwaukee, Wis.

Working Group on Project 52.1—Location and Design of Distribution Substations in Residential Areas

O. J. Rotty, *Chairman;* Union Electric Company of Missouri, St. Louis, Mo.

J. W. Erven	Los Angeles, Calif.
C. S. Fiske	Baltimore, Md.
E. M. Hunter	Schenectady, N. Y.
P. R. Pierson	East Pittsburgh, Pa.

Working Group on Project 53.2—Design and Utilization of Mobile Substations

H. H. Marsh, Jr., *Chairman;* Duquesne Light Company, Pittsburgh, Pa.

J. R. Dickey	Corpus Christi, Texas
G. F. Gleason	Rochester, N. Y.
J. A. Smith	Schenectady, N. Y.
P. R. Spracher	Richmond, Va.

Conversion Substation Subcommittee

M. E. Reagan, *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

R. R. Godard	Uniontown, Pa.
D. C. Hoffmann	Philadelphia, Pa.
A. D. Millikin	Milwaukee, Wis.
D. S. Sandlin	Freeport, Texas
S. S. Watkins	New York, N. Y.
C. H. Youngdahl	Chicago, Ill.

Automatic and Supervisory Control Subcommittee

Herman Bany, *Chairman;* General Electric Company, 6901 Elmwood Ave., Philadelphia 42, Pa.

J. F. Bracken	Chicago, Ill.
H. W. Buss	Rochester, N. Y.

W. A. Clark	New York, N. Y.
G. E. Farmer	Signal Mountain, Tenn.
W. M. Larson	Minneapolis, Minn.
M. E. Reagan	East Pittsburgh, Pa.
J. W. Savage	Los Angeles, Calif.
M. S. Schneider	Cincinnati, Ohio
J. J. Winsness	Philadelphia, Pa.

Working Group on Device Function Numbers

Herman Bany, *Chairman;* General Electric Company, Philadelphia, Pa.

A. N. Eliasen	Chicago, Ill.
M. E. Reagan	East Pittsburgh, Pa.
M. S. Schneider	Cincinnati, Ohio

West Coast Subcommittee

R. F. Gibbons, *Chairman;* Pacific Electric Manufacturing Co., Air Break Engg. Div., 333 Brokan Road, Santa Clara, Calif.

(*Personnel to be selected*)

Committee on Switchgear

J. D. Wood, *Chairman;* I-T-E Circuit Breaker Co., 19th & Hamilton Sts., Philadelphia 30, Pa.

J. C. Woods, *Vice-Chairman*	Chicago, Ill.
K. J. C. Falck, *Secretary*	Philadelphia, Pa.
J. S. Ambrose	Detroit, Mich.
C. E. Asbury	Jackson, Mich.
C. H. Baker	Chicago, Ill.
K. M. Bausch	San Francisco, Calif.
R. M. Bennett	Philadelphia, Pa.
E. W. Boehne	Cambridge, Mass.
J. S. Brown	Pittsburgh, Pa.
W. B. Brown	Peterboro, Ont., Canada
B. M. Carothers	St. Louis, Mo.
J. L. Carr	Washington, D. C.
E. A. Childerhose	Boston, Mass.
H. W. Codding	Newark, N. J.
V. L. Cox	Philadelphia, Pa.
G. K. Ditlow	Washington, D. C.
R. M. Ferrill	Chattanooga, Tenn.
J. M. Geiger	Buffalo, N. Y.
W. J. Gilson	Toronto, Ont., Canada
J. W. Graff	Birmingham, Ala.
J. R. Guy	Cleveland, Ohio
V. J. Hayes	Hartford, Conn.
T. J. Higgins	Madison, Wis.
A. W. Hill	East Pittsburgh, Pa.
G. L. Hill	Emeryville, Calif.
P. M. Holtz	Allentown, Pa.
A. A. Johnson	East Pittsburgh, Pa.
R. M. Jolly	San Antonio, Texas
C. L. Killgore	Denver, Colo.
I. T. Knight	Kansas City, Mo.
F. A. Lane	New York, N. Y.
W. A. Lewis	Chicago, Ill.
H. L. Lowe	New York, N. Y.
W. B. Mann	Baltimore, Md.
D. J. Marsden	San Francisco, Calif.
J. E. Martin	Denver, Colo.
J. W. May	Philadelphia, Pa.
F. W. McCloska	Chicago, Ill.
W. J. McLachlan	Schenectady, N. Y.
V. G. Muzsnay	Schenectady, N. Y.
C. E. Poovey	Charlotte, N. C.
G. M. Reed	Philadelphia, Pa.
E. K. Sadler	Los Angeles, Calif.
C. A. Schehl	Philadelphia, Pa.
A. C. Schwager	Portland, Oreg.
D. F. Shankle	East Pittsburgh, Pa.
O. L. Sidenfaden	Los Angeles, Calif.
T. G. A. Sillers	West Allis, Wis.
E. A. Stroberg	Boston, Mass.
D. M. Umphrey	San Francisco, Calif.
Abe Uretsky	St. Catharines, Ont., Canada
Anthony Van Ryan	South Milwaukee, Wis.
J. H. Vivian	Los Angeles, Calif.
Milton Wagner, Jr.	Dayton, Ohio
R. L. Webb	New York, N. Y.
C. P. West	East Pittsburgh, Pa.
Paul Wildi	Tacoma, Wash.
C. P. Zimmerman	New York, N. Y.

Power Circuit Breaker Subcommittee

R. M. Bennett, *Chairman;* General Electric Company, 6901 Elmwood Avenue, Philadelphia 42, Pa.

E. A. Childerhose	Boston, Mass.
K. G. Darrow	Philadelphia, Pa.
R. M. Ferrill	Chattanooga, Tenn.
R. E. Friedrich	East Pittsburgh, Pa.
E. J. Harrington	Portland, Oreg.
G. E. Hertig	Jackson, Mich.
C. L. Killgore	Denver, Colo.
F. A. Lane	New York, N. Y.
J. W. May	Philadelphia, Pa.
H. H. Mitchell	Los Angeles, Calif.
O. L. Sidenfaden	Los Angeles, Calif.
T. G. A. Sillers	West Allis, Wis.
D. M. Umphrey	San Francisco, Calif.
O. B. Vikoren	Philadelphia, Pa.
R. L. Webb	New York, N. Y.
C. A. Woodrow	Schenectady, N. Y.

Switchgear Assemblies Subcommittee

C. P. West, *Chairman;* Westinghouse Electric Corp., East Pittsburgh, Pa.

H. J. Chambers	Toronto, Ont., Canada
H. G. Frus	Pittsburgh, Pa.
J. M. Geiger	Buffalo, N. Y.
W. G. Harlow	Havertown, Pa.
R. M. Jolly	San Antonio, Tex.
D. M. Langston	Santa Clara, Calif.
H. L. Lowe	New York, N. Y.
F. W. McCloska	Chicago, Ill.
I. S. Mendenhall	Detroit, Mich.
G. H. Moorhead, Jr.	Los Angeles, Calif.
H. A. Norberg	Tulsa, Okla.
B. K. Sturgis	Philadelphia, Pa.
J. W. Timmerman	Waukesha, Wis.

Low Voltage Air Circuit Breakers Subcommittee

F. W. McCloska, *Chairman;* Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill.

B. S. Beall	Philadelphia, Pa.
M. S. Carlson	Philadelphia, Pa.
B. M. Carothers	St. Louis, Mo.
C. L. Killgore	Denver, Colo.
H. J. Lingal	East Pittsburgh, Pa.
J. W. Timmerman	Waukesha, Wis.

Administrative Subcommittee

J. C. Woods, *Chairman;* Commonwealth Edison Co., 72 West Adams St., Chicago 90, Ill.

R. M. Bennett	Philadelphia, Pa.
K. J. C. Falck	Philadelphia, Pa.
J. M. Geiger	Buffalo, N. Y.
F. W. McCloska	Chicago, Ill.
Anthony Van Ryan	South Milwaukee, Wis.
R. L. Webb	New York, N. Y.
C. P. West	East Pittsburgh, Pa.
C. P. Zimmerman	New York, N. Y.

Switches, Fuses and Insulators Subcommittee

C. P. Zimmerman, *Chairman;* American Gas and Electric Service Corp., 30 Church Street, New York 7, N. Y.

R. H. Amundson	South Milwaukee, Wis.
C. H. Baker	Chicago, Ill.
T. E. Curtis	Hampton, Ga.
G. K. Ditlow	Washington, D. C.
G. L. Hill	Emeryville, Calif.
K. J. C. Falck	Philadelphia, Pa.
J. H. Lingal	East Pittsburgh, Pa.
J. C. Lebens	St. Louis, Mo.
J. B. Owens	Greensburg, Pa.
A. H. Powell	Philadelphia, Pa.
F. W. Rich	Jackson, Mich.
S. R. Smith, Jr.	Pittsfield, Mass.
J. C. Woods	Chicago, Ill.
A. C. Schwager	Portland, Oregon

Automatic Circuit Reclosers and Line Sectionalizers Subcommittee

Anthony Van Ryan, *Chairman;* Kyle Co., South Milwaukee, Wis.

L. B. Crann	Washington, D. C.
H. H. Fahnoe	East Pittsburgh, Pa.
E. J. Field	Greensburg, Pa.
J. T. Finley, Jr.	St. Louis, Mo.
J. R. Guy	Cleveland, Ohio
R. D. Hambrick	San Francisco, Calif.
G. E. Hertig	Jackson, Mich.
W. C. Mitchell	Media, Pa.

Committee on System Engineering

A. P. Hayward, *Chairman;* Duquesne Light Co., 435 Sixth Ave., Pittsburgh, 19, Pa.

R. T. Purdy, *Vice-Chairman*	Chicago, Ill.
H. C. Otten, *Secretary*	New York, N. Y.
E. C. Brown	Hartford, Conn.
D. H. Cameron	Kansas City, Mo.
O. E. Charlton	Birmingham, Ala.
S. B. Farnham	Schenectady, N. Y.
A. P. Fugill	Detroit, Mich.
W. A. Gallotte	Seattle, Wash.
E. E. George	Little Rock, Ark.
A. C. Hartranft	Philadelphia, Pa.
N. G. Hodgman	Boston, Mass.
R. G. Hooke	Newark, N. J.
Otis Howard	Oklahoma City, Okla.
J. P. Jolliffee	Portland, Oreg.
C. B. Kelley	Des Moines, Iowa
M. H. Kight	Denver, Colo.
L. K. Kirchmayer	Schenectady, N. Y.
H. J. Klumb	Rochester, N. Y.
E. W. Knapp	Montreal, Que., Canada
R. F. Lawrence	East Pittsburgh, Pa.
L. B. LeVesconte	Chicago, Ill.
W. B. Loper	Riverside, Calif.
H. A. Lott	Los Angeles, Calif.
M. H. Lovelady	Corpus Christi, Texas
S. H. Lull	Springfield, Mass.
W. J. Lyman	Pittsburgh, Pa.
M. H. MacKenzie	Toronto, Ont., Canada
G. H. McDaniel	New York, N. Y.
C. N. Metcalf	New York, N. Y.
E. L. Michelson	Chicago, Ill.
B. H. Mount	East Pittsburgh, Pa.
Clark Nichols	Philadelphia, Pa.
W. H. Osterle	Pittsburgh, Pa.
C. E. Parks	Plainfield, Ind.
L. R. Patterson	Denver, Colo.
H. W. Phillips	Philadelphia, Pa.
J. H. Rixse, Jr.	Washington, D. C.
T. W. Schroeder	Decatur, Ill.
J. G. Tarboux	Ann Arbor, Mich
J. J. Tesar	Cleveland, Ohio
M. J. Thrasher	Hicksville, N. Y.
J. E. VanNess	Evanston, Ill.
D. C. Vaughan	Washington, D. C.
H. J. Vick	Madison, Wis.
J. B. Ward	Lafayette, Ind.
Charles Wasserman	Baltimore, Md.
C. W. Watchorn	Baltimore, Md.
G. S. Whitlow	St. Louis, Mo.
W. D. Wilder	Buffalo, N. Y.
S. N. Witts	Minneapolis, Minn.
S. H. Wright	San Francisco, Calif.

Administrative Subcommittee

A. P. Hayward, *Chairman;* Duquesne Light Co., 435 Sixth Ave., Pittsburgh 19, Pa.

E. E. George	Little Rock, Ark.
A. C. Hartranft	Philadelphia, Pa.
R. G. Hooke	Newark, N. J.
C. B. Kelley	Des Moines, Iowa
H. A. Lott	Los Angeles, Calif.
G. H. McDaniel	New York, N. Y.
C. N. Metcalf	New York, N. Y.
H. C. Otten	New York, N. Y.
R. T. Purdy	Chicago, Ill.

System Planning Subcommittee

R. G. Hooke, *Chairman;* Public Service Elec. & Gas Co., 80 Park Place, Newark 1, N. J.

O. E. Charlton	Birmingham, Ala.
G. C. Conner	Portland, Oreg.
A. P. Fugill	Detroit, Mich.
W. A. Gallotte	Seattle, Wash.
O. L. Giersch	Charlotte, N. C.
J. R. Hango	Montreal, Que., Canada
R. F. Lawrence	East Pittsburgh, Pa.
L. B. LeVesconte	Chicago, Ill.
S. H. Lull	Springfield, Mass.
M. H. MacKenzie	Toronto, Ont., Canada
E. L. Michelson	Chicago, Ill.
W. H. Osterle	Pittsburgh, Pa.
L. R. Patterson	Denver, Colorado
J. H. Rixse, Jr.	Washington, D. C.
T. W. Schroeder	Decatur, Ill.
J. J. Tesar	Cleveland, Ohio
D. C. Vaughan	Washington, D. C.
H. J. Vick, Jr.	Madison, Wis.
G. S. Whitlow	St. Louis, Mo.
S. N. Witts	Minneapolis, Tenn.

System Economics Subcommittee

E. E. George, *Chairman;* Ebasco Services, Inc., P.O. Box 2899, Little Rock, Ark.

E. C. Brown	Hartford, Conn.
J. J. Carey	Ann Arbor, Mich.
L. K. Kirchmayer	Schenectady, N. Y.
E. W. Knapp	Montreal, Que., Canada
B. H. Mount	East Pittsburgh, Pa.
H. W. Phillips	Philadelphia, Pa.
J. G. Tarboux	Ann Arbor, Mich.
J. E. VanNess	Evanston, Ill.
J. B. Ward	Lafayette, Ind.
C. W. Watchorn	Baltimore, Md.

System Operations Subcommittee

A. C. Hartranft, *Chairman;* Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, Pa.

D. H. Cameron	Kansas City, Mo.
S. B. Farnham	Schenectady, N. Y.
Otis Howard	Oklahoma City, Okla.
J. P. Jolliffe	Portland, Oreg.
W. J. Kelley	Decatur, Ill.
M. H. Kight	Denver, Colo.
H. J. Klumb	Rochester, N. Y.
W. P. Loper	Riverside, Calif.
M. H. Lovelady	Corpus Christi, Texas
W. J. Lyman	Pittsburgh, Pa.
C. E. Parks	Plainfield, Ind.
N. S. Spatz	Newark, N. J.
W. D. Wilder	Buffalo, N. Y.
S. H. Wright	San Francisco, Calif.

System Controls Subcommittee

C. N. Metcalf, *Chairman;* Consolidated Edison Co. of N. Y., Inc., 4 Irving Place, New York 3, N. Y.

O. R. Bulkley	Los Angeles, Calif.
W. H. Burnham	West Lynn, Mass.
R. F. Cornell	Albany, N. Y.
E. D. Early	Birmingham, Ala.
N. G. Hodgman	Boston, Mass.
F. I. Lawson	San Francisco, Calif.
G. H. McDaniel	New York, N. Y.
Clark Nichols	Philadelphia, Pa.
M. J. Thrasher	Hicksville, N. Y.
Charles Wasserman	Baltimore, Md.

Far West Subcommittee

H. A. Lott, *Chairman;* Southern California Edison Co., 601 West 5th Street, Los Angeles, Calif.

(*Personnel to be selected*)

Committee on Transformers

J. A. Adams, *Chairman;* Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, Pa.

J. R. Meador, *Vice-Chairman*	Pittsfield, Mass.
M. H. Pratt, *Secretary*	Syracuse, N. Y.
C. H. Bjorquist	Portland, Oreg.
T. J. Bliss	East Pittsburgh, Pa.
H. E. Bonheimer	Cleveland, Ohio
K. W. Boyles	Birmingham, Ala.
M. K. Brown	Buffalo, N. Y.
R. J. Brown	Toronto, Ont., Canada
R. L. Brown	Sharon, Pa.
J. L. Cantwell	Pittsfield, Mass.
J. H. Chiles, Jr.	Sharon, Pa.
J. E. Clem	Schenectady, N. Y.
R. E. Franck	Lynn, Mass.
W. F. Griffard	Jackson, Mich.
E. M. Gue	Pittsburgh, Pa.
W. L. Hetherington	St. Catharines, Ont., Canada
J. B. Hodtum	Pittsburgh, Pa.
A. V. Hughes	Bay City, Mich.
D. L. Levine	Chicago, Ill.
C. M. Lovell	St. Louis, Mo.
C. W. Miller	Sharon, Pa.
W. W. Orr	Guelph, Ont., Canada
H. R. Osborne	Toronto, Ont., Canada
P. S. Pugh	New York, N. Y.
R. W. Schlie	Washington, D. C.
W. C. Sealey	Milwaukee, Wis.
P. D. Smith	Mimico, Ont., Canada
K. M. Stevens	Alhambra, Calif.
H. V. Strandberg	Seattle, Wash.
P. A. Vance	Fort Wayne, Ind.
F. J. Vogel	Milwaukee, Wis.
H. H. Wagner	Canonsburg, Pa.
P. L. Weir	Washington, D. C.
W. C. Whitman	Boston, Mass.
C. P. Xenis	New York, N. Y.
J. W. Yettor	Schenectady, N. Y.

Subcommittee on Dielectric Tests

F. J. Vogel, *Chairman;* Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

C. H. Bjorquist	Portland, Oreg.
H. E. Bonheimer	Cleveland, Ohio
V. F. Christen	St. Louis, Missouri
J. E. Clem	Schenectady, N. Y.
W. F. Dunkle	Hazleton, Pa.
W. F. Griffard	Jackson, Mich.
I. W. Gross	New York, N. Y.
E. M. Gue	Pittsburgh, Pa.
D. M. MacGregor	New York, N. Y.
W. R. McCarty	St. Louis, Mo.
J. R. Meador	Pittsfield, Mass.
C. W. Miller	Sharon, Pa.
W. C. Sealey	Milwaukee, Wis.
W. L. Teague	Sharon, Pa.
J. A. VanLund	Pittsfield, Mass.
W. C. Whitman	Boston, Mass.

Working Group on Revision of Guide for Loading Oil-Immersed Distribution and Power Transformers

R. L. Brown, *Chairman;* Westinghouse Electric Corporation, Sharon, Pa.

G. H. Halsey	Pittsfield, Mass.
D. L. Levine	Chicago, Ill.
R. J. Salsbury	Pittsburgh, Pa.
R. C. Smith	Philadelphia, Pa.
F. J. Vogel	Milwaukee, Wis.
C. P. Xenis	New York, N. Y.

Working Group on Insulation Requirements for Specialty Transformers

P. A. Vance, *Chairman;* General Electric Co., 1635 Broadway, Fort Wayne 2, Ind.

A. G. Fockler	Clifton, N. J.
A. V. Hughes	Bay City, Mich.
L. W. Kirkwood	Murray Hill, N. J.
T. F. Saffold	Sharon, Pa.
C. F. Salt, Jr.	Columbus, Ohio
M. W. Sims	Fort Wayne, Ind.

Subcommittee on Insulation Life

J. L. Cantwell, *Chairman;* General Electric Company, 100 Woodlawn Avenue, Pittsfield, Mass.

Working Group on Life of Materials

C. E. Arntzen	East Pittsburgh, Pa.
F. M. Clark	Schenectady, N. Y.
T. W. Dakin	East Pittsburgh, Pa.
J. F. Dexter	Midland, Mich.
B. E. Ely	Wilmington, Del.
M. L. Manning	Cannonsburg, Pa.
J. S. Parkinson	Manville, N. J.
W. W. Satterlee	Sharon, Pa.
W. M. Terry, Jr.	Pittsburgh, Pa.
F. J. Vogel	Milwaukee, Wis.
T. R. Walters	Pittsfield, Mass.
H. G. Zambell	Pittsburgh, Pa.

Working Group on Methods of Making Temperature Rise Tests on Transformers

C. W. Miller, *Chairman;* Westinghouse Electric Corporation, Sharon, Pa.

M. F. Beavers	Pittsfield, Mass.
J. E. Clem	Schenectady, N. Y.
H. B. Keath	St. Louis, Mo.
A. J. Maslin	Sharon, Pa.
W. H. Mutschler, Jr.	Pittsburgh, Pa.
Paul Narbut	Sharon, Pa.
S. O. Schamberger	Albany, N. Y.
R. C. Smith	Philadelphia, Pa.
W. C. Whitman	Boston, Mass.

Subcommittee on Insulating Fluids

C. P. Xenis, *Chairman;* Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York 3, New York

V. L. Cox	Philadelphia, Pa.
F. C. Doble	Belmont, Mass.
J. G. Ford	Sharon, Pa.
I. W. Gross	New York, N. Y.
R. B. Kaufman	Pittsfield, Mass.
E. L. Raab	Pittsfield, Mass.
W. W. Satterlee	Sharon, Pa.

Subcommittee on Magnetic Behavior

J. H. Chiles, Jr., *Chairman;* Transformer Division, Westinghouse Electric Corporation, Sharon, Pa.

Working Group on Audible Noise

J. H. Chiles, Jr., *Chairman;* Transformer Division, Westinghouse Electric Corporation, Sharon, Pa.

J. E. Clem	Schenectady, N. Y.
L. C. Edwards	Emeryville, Calif.
D. L. Levine	Chicago, Ill.
A. J. Maslin	Sharon, Pa.
T. D. Reimers	New York, N. Y.
M. W. Schulz	Pittsfield, Mass.
J. M. Towner	Baltimore, Md.
F. Von Voightlander	Adrian, Mich.

Subcommittee on Performance Characteristics

D. L. Levine, *Chairman;* Commonwealth Edison Company, 72 West Adams St., Chicago 90, Ill.

Working Group on Revision of Reactor Standards

D. L. Levine, *Chairman;* Commonwealth Edison Company, 72 West Adams St., Chicago 90, Ill.

J. E. Clem	Schenectady, N. Y.
R. B. Gear	Chicago, Ill.
C. V. Moberg	Baltimore, Md.
E. Nilson	San Francisco, Calif.
J. C. Russ	Pittsfield, Mass.
L. E. Sauer	Sharon, Pa.
O. E. Sawyer	Providence, R. I.
O. L. Sidenfaden	Los Angeles, Calif.
O. B. Vikoren	Philadelphia, Pa.
C. L. Wagner	East Pittsburgh, Pa.

Working Group on Instrument Transformers

R. E. Franck, *Chairman;* General Electric Company, Lynn, Mass.

H. Bany	Philadelphia, Pa.
J. H. Chiles, Jr.	Sharon, Pa.
R. E. Cordray	Philadelphia, Pa.
A. B. Craig	Boston, Mass.
F. E. Davis, Jr.	Jackson, Mich.
K. J. Falck	Philadelphia, Pa.
J. M. Geiger	Buffalo, N. Y.
T. R. Hallman	Detroit, Mich.
E. K. Huntington	Rochester, N. Y.
L. F. Kennedy	Schenectady, N. Y.
J. H. Kinghorn	New York, N. Y.
D. B. Masters	Jackson, Mich.
J. P. Scott	St. Louis, Mo.
F. B. Silsbee	Washington, D. C.
W. E. Sonneman	Newark, N. J.
W. M. Terry	Pittsburgh, Pa.
E. C. Wentz, Jr.	Sharon, Pa.
C. A. Woods	East Pittsburgh, Pa.

Liaison with Other Committees on Converters

W. C. Sealey	Milwaukee, Wis.

West Coast Subcommittee

C. H. Bjorquist, *Chairman;* Bonneville Power Administration, Portland 8, Oregon

(*Personnel to be selected*)

Committee on Transmission and Distribution

F. V. Smith, *Chairman;* Sargent & Lundy, 140 South Dearborn Street, Chicago 3, Ill.

T. J. Brosnan, *Vice-Chairman*	Buffalo, N. Y.
J. T. Lusignan, Jr., *Secretary*	Mansfield, Ohio
A. H. Anderson	Toronto, Ont., Canada
C. E. Baugh	San Francisco, Calif.
P. L. Bellaschi	Portland, Oreg.
H. C. Bingham	Cleveland, Ohio
D. K. Blake	Schenectady, N. Y.
C. A. Booker	Boston, Mass.
W. R. Bullard	New York, N. Y.
R. M. Butler	Schenectady, N. Y.
L. L. Carter	Hastings-on-Hudson, N. Y.
E. R. Coulbourn	Birmingham, Ala.
P. J. Croft	Toronto, Ont., Canada
H. L. Davis, Jr.	Philadelphia, Pa.
O. A. Demuth	Portland, Oreg.
J. K. Dillard	East Pittsburgh, Pa.
Byron Evans	Denver, Colo.
H. A. Frey	Baltimore, Md.
Eduard Fritz	Philadelphia, Pa.
E. T. B. Gross	Arlington Heights, Ill.
J. H. Hagenguth	Pittsfield, Mass.
K. E. Hapgood	Chattanooga, Tenn.
E. L. Harder	East Pittsburgh, Pa.
E. R. Hendrickson	Chicago, Ill.
E. K. Huntington	Rochester, N. Y.
Thomas Ingledow	Vancouver, B. C., Canada
P. A. Jeanne	New York, N. Y.
I. B. Johnson	Schenectady, N. Y.
C. A. Jordon	Perth Amboy, N. J.
E. L. Kanouse	Los Angeles, Calif.
C. H. Kraft	St. Louis, Mo.
J. E. Lagerstrom	Ames, Iowa
Dixon Lewis	Pittsburgh, Pa.
A. L. Malmstrom	Detroit, Mich.
D. W. Nethercut	Jackson, Mich.
J. P. Neubauer	New York, N. Y.
J. E. O'Brien	Washington, D. C.
C. E. Parks	Plainfield, Ind.
C. K. Poarch	New York, N. Y.

J. A. Rawls	Richmond, Va.
L. M. Robertson	Denver, Colo.
H. L. Rorden	New York, N. Y.
H. P. St. Clair	New York, N. Y.
E. V. Sayles	Jackson, Mich.
A. N. Shealy	Baltimore, Md.
E. C. Starr	Corvallis, Oreg.
J. A. Strelzoff	East Lansing, Mich.
R. E. Thornton	Oklahoma City, Okla.
C. F. Wagner	East Pittsburgh, Pa.
P. G. Wallace	Dallas, Texas
A. B. Weaver	Corpus Christi, Texas
L. J. Weed	Boston, Mass.
Herbert Westman	Montreal, Que., Canada

Capacitor Subcommittee

C. E. Parks, *Chairman;* Public Service Co. of Indiana, Inc., 1000 East Main Street, Plainfield, Ind.

P. L. Bellaschi	Portland, Oreg.
L. S. Billman	South Plainfield, N. J.
R. M. Butler	Schenectady, N. Y.
E. R. Coop	Providence, R. I.
W. E. Fowler	Fort Worth, Texas
K. E. Hapgood	Chattanooga, Tenn.
M. F. Leftwich	Charlotte, N. C.
R. E. Marbury	East Pittsburgh, Pa.
L. Podolsky	North Adams, Mass.
F. M. Porter	New York, N. Y.
B. H. Schultz	South Milwaukee, Wis.
M. E. Scoville	Hudson Falls, N. Y.
E. C. Starr	Corvallis, Oreg.
C. J. Waldron	Washington, D. C.
P. G. Wallace	Dallas, Tex.
L. T. Williams	Shreveport, La.

Distribution Subcommittee

E. R. Hendrickson, *Chairman;* Public Service Division of Commonwealth Edison Co., 72 West Adams Street, Chicago, Ill.

R. B. Bailey	Birmingham, Ala.
H. G. Barnett	East Pittsburgh, Pa.
C. E. Baugh	San Francisco, Calif.
H. C. Bingham	Cleveland, Ohio
D. K. Blake	Schenectady, N. Y.
T. J. Brosnan	Buffalo, N. Y.
W. R. Bullard	New York, N. Y.
H. L. Davis, Jr.	Philadelphia, Pa.
S. E. Goodell	Chicago, Ill.
J. B. Hodtum	Pittsburgh, Pa.
E. K. Huntington	Rochester, N. Y.
C. H. Kraft	St. Louis, Mo.
Dixon Lewis	Pittsburgh, Pa.
D. W. Nethercut	Jackson, Mich.
J. E. O'Brien	Washington, D. C.
E. V. Sayles	Jackson, Mich.
J. A. Strelzoff	East Lansing, Mich.
A. H. Thayer	Los Angeles, Calif.
R. E. Thornton	Oklahoma City, Okla.
A. B. Weaver	Corpus Christi, Texas
L. J. Weed	Boston, Mass.

General Systems Subcommittee

I. B. Johnson, *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

F. L. Code	Toronto, Ont., Canada
O. A. Demuth	Portland, Oreg.
J. K. Dillard	East Pittsburgh, Pa.
R. W. Ferguson	East Pittsburgh, Pa.
E. T. B. Gross	Chicago, Ill.
P. A. Jeanne	New York, N. Y.
A. A. Kroneberg	Los Angeles, Calif.
J. E. Lagerstrom	Ames, Iowa
F. H. Linsley	Hartford, Conn.
J. P. Neubauer	New York, N. Y.
H. A. Peterson	Madison, Wis.
L. M. Robertson	Denver, Colo.
A. J. Schultz	Schenectady, N. Y.
H. P. St. Clair	New York, N. Y.

Lightning & Insulation Subcommittee

H. A. Frey, *Chairman;* Locke Insulator Corp., Inc., Baltimore, Md.

J. M. Clayton, Jr.	East Pittsburgh, Pa.
G. E. Dean	Newark, N. J.
H. N. Ekvall	Philadelphia, Pa.
I. W. Gross	New York, N. Y.
J. H. Hagenguth	Pittsfield, Mass.
E. L. Harder	East Pittsburgh, Pa.
L. V. LeVesconte	Chicago, Ill.
W. W. Lewis	Schenectady, N. Y.
J. T. Lusignan, Jr.	Mansfield, Ohio
H. L. Rorden	Portland, Oreg.
S. K. Waldorf	Lancaster, Pa.
E. R. Whitehead	Chicago, Ill.
S. W. Zimmerman	Ithaca, N. Y.

Towers, Poles & Conductors Subcommittee

E. L. Kanouse, *Chairman;* Dept. of Water & Power, City of Los Angeles, 207 South Broadway, Box 3669, Terminal Annex, Los Angeles, Calif.

H. W. Adams	Louisville, Ky.
A. H. Anderson	Toronto, Ont., Canada
N. K. Barr	Chicago, Ill.
C. A. Booker	Boston, Mass.
L. L. Carter	Hastings-on-Hudson, N. Y.
R. W. Caswell	Chicago, Ill.
E. R. Coulbourn	Birmingham, Ala.
P. J. Croft	Toronto, Ontario, Canada
K. T. Deutsch	Denver, Colo.
Eduard Fritz	Philadelphia, Pa.
K. E. Hapgood	Chattanooga, Tenn.
Thomas Ingledow	Vancouver, B. C., Canada
C. A. Jordan	Perth Amboy, N. J.
A. L. Malmstrom	Detroit, Mich.
J. E. O'Brien	Washington, D. C.
T. F. Peterson	Cleveland, Ohio
J. A. Rawls	Richmond, Va.
L. M. Robertson	Denver, Colo.
A. S. Runciman	Shawinigan Falls, Que., Canada
A. N. Shealy	Baltimore, Md.
Joel Thompkins	Massena, N. Y.
Herbert Westman	Shawinigan Falls, Que., Canada
E. M. Wright	San Francisco, Calif.
R. G. Yerk	Seward, Nebr.

Science and Electronics Division

Science and Electronics Division Committee

S. R. Warren, Jr., *Chairman;* University of Pennsylvania, Towne Building, Room 109, 220 South 33rd Street, Philadelphia 4, Pa.

J. G. Reid, Jr., *Vice-Chairman*	Alexandria, Va.
R. S. Gardner, *Secretary*	New York, N. Y.
W. E. Barbour, Jr.	Boston, Mass.
L. J. Berberich	East Pittsburgh, Pa.
R. M. Bozorth	Murray Hill, N. J.
W. R. Clark	Philadelphia, Pa.
W. J. Dornhoefer	Paterson, N. J.
W. G. Dow	Ann Arbor, Mich.
J. E. Hobson	Stanford, Calif.
E. S. Lammers *(Representing Board of Directors)*	Atlanta, Ga.
J. T. Lusignan, Jr.	Mansfield, Ohio
F. J. Maginniss	Schenectady, N. Y.
Glen Ramsey	North Chicago, Ill.
H. C. Steiner	Schenectady, N. Y.
E. D. Trout	Milwaukee, Wis.

Committee on Basic Sciences

L. J. Berberich, *Chairman;* Liaison Engg. Dept., 7-L Westinghouse Electric Corp., East Pittsburgh, Pa.

W. R. LePage, *Vice-Chairman*	Syracuse, N. Y.
S. B. Batdorf, *Secretary*	East Pittsburgh, Pa.
P. A. Abetti	Pittsfield, Mass.
W. G. Amey	Philadelphia, Pa.
S. S. Attwood	Ann Arbor, Mich.
W. B. Boast	Ames, Iowa
S. W. Booth	White Oak, Md.
Aram Boyajian	Pittsfield, Mass.
R. M. Bozorth	Murray Hill, N. J.
J. G. Brainerd	Philadelphia, Pa.
C. G. Brennecke	Raleigh, N. C.
E. M. Brohl	Flint, Mich.
C. B. Brown	White Oak, Md.
H. J. Carlin	Brooklyn, N. Y.
T. W. Dakin	East Pittsburgh, Pa.
J. F. Dexter	Midland, Mich.
W. C. Dunlap, Jr.	Schenectady, N. Y.
L. H. Fisher	New York, N. Y.
E. A. Guillemin	Cambridge, Mass.
Ferdinand Hamburger, Jr.	Baltimore, Md
G. T. Harness	Los Angeles, Calif.
J. D. Heibel	Erie, Pa.
V. P. Hessler	Urbana, Ill.
T. J. Higgins	Madison, Wis.
P. M. Honnell	St. Louis, Mo.
T. B. Jones	Baltimore, Md.
Robert Kahal	Monterey, Calif.
V. E. Legg	Murray Hill, N. J.
L. J. Lewis	Seattle, Wash.
W. A. Lewis, Jr.	Chicago, Ill.
M. G. Malti	Ithaca, N. Y.
H. F. Mathis	Norman, Okla.
L. W. Matsch	Chicago, Ill.
A. C. Munster	Philadelphia, Pa.
N. V. Petrou	Baltimore, Md.
L. A. Pipes	Los Angeles, Calif.
Emerson Pugh	Chicago, Ill.
W. D. Rowe	East Pittsburgh, Pa.
G. M. Roy	Richland, Wash.
J. H. Simpson	Ottawa, Ont., Canada
V. G. Smith	Toronto, Ont., Canada
Harry Sohon	Philadelphia, Pa.
G. M. L. Sommerman	Columbus, Ohio
E. C. Starr	Corvallis, Oreg.
J. A. Strelzoff	East Lansing, Mich.
J. D. Tebo	New York, N. Y.
W. A. Thomas	Cleveland, Ohio
D. H. Toth	St. Paul, Minn.
J. H. Wright	West Lynn, Mass.

Applied Mathematics Subcommittee

M. G. Malti, *Chairman;* Cornell University School of Electrical Engineering, Ithaca, N. Y.

P. A. Abetti	Pittsfield, Mass.
P. L. Alger	Schenectady, N. Y.
Garrett Birkhoff	Cambridge, Mass.
D. G. Bourgin	Urbana, Ill.
Aram Boyajian	Pittsfield, Mass.
R. J. Duffin	Pittsburgh, Pa.
W. H. J. Fuchs	Ithaca, New York
M. F. Gardner	Cambridge, Mass.
E. A. Guillemin	Cambridge, Mass.
A. E. Heins	Pittsburgh, Pa.
Mark Kac	Ithaca, N. Y.
W. R. LePage	Syracuse, N. Y.
P. C. Magnusson	Corvallis, Oreg.
L. A. Pipes	Los Angeles, Calif.
Harry Pollard	Ithaca, N. Y.
J. J. Smith	Schenectady, N. Y.
Harry Sohon	Philadelphia, Pa.
Joseph Slepian	East Pittsburgh, Pa.
J. J. Stoker	New York, N. Y.
J. W. Tukey	Murray Hill, N. J.
John von Neumann	Princeton, N. J.
D. W. Widder	Cambridge, Mass.
Norbert Wiener	Cambridge, Mass.
Max Woodbury	Ann Arbor, Mich.

Electric Circuit Theory Subcommittee

W. R. LePage, *Chairman;* Dept. of Elec. Engg., Syracuse University, Syracuse 10, N. Y.

P. A. Abetti	Pittsfield, Mass.
J. G. Brainerd	Philadelphia, Pa.
H. J. Carlin	Brooklyn, N. Y.
R. L. Dietzold	Murray Hill, N. J.
A. B. Giordano	Brooklyn, N. Y.
E. A. Guillemin	Cambridge, Mass.
E. L. Harder	East Pittsburgh, Pa.
T. J. Higgins	Madison, Wis.
G. B. Hoadley	Raleigh, N. C.
W. C. Johnson	Princeton, N. J.
Robert Kahal	Monterey, Calif.
Y. H. Ku	Philadelphia, Pa.
R. C. Lewis	Los Angeles, Calif.
A. B. Macnee	Ann Arbor, Mich.
M. E. Mohr	Culver City, Calif.
P. F. Ordung	New Haven, Conn.
J. J. Suran	Syracuse, N. Y.
R. M. Wainwright	Urbana, Ill.

Magnetics Subcommittee

R. M. Bozorth, *Chairman;* Bell Telephone Labs., Inc., Murray Hill, N. J.

A. C. Beiler	East Pittsburgh, Pa.
E. Both	Fort Monmouth, N. J.
F. G. Brockman	Irvington-on-Hudson, N. Y.
R. A. Chegwidden	Murray Hill, N. J.
E. A. Gaugler	Butler, Pa.
J. E. Goldman	Pittsburgh, Pa.
M. F. Littmann	Middletown, Ohio
L. R. Maxwell	Silver Spring, Md.
W. H. Meiklejohn	Schenectady, N. Y.
W. Morrill	Pittsfield, Mass.
J. A. Osborn	East Pittsburgh, Pa.

Dielectrics Subcommittee

L. J. Berberich, *Chairman;* Liaison Engineering, Westinghouse Electric Corp., East Pittsburgh, Pa.

W. G. Amey	Philadelphia, Pa.
S. C. Brown	Cambridge, Mass.
F. M. Clark	Schenectady, N. Y.
J. D. Cobine	Schenectady, N. Y.
J. W. Deaderick	Chattanooga, Tenn.
J. F. Dexter	Midland, Mich.
Paul Doigan	Pittsfield, Mass.
J. L. Fuller	Cleveland, Ohio
J. D. Heibel	Erie, Pa.
J. B. Jones	Baltimore, Md.
D. W. Kitchin	Cambridge, Mass.
G. T. Kohman	Murray Hill, N. J.

J. L. Kuehlthau	Milwaukee, Wis.
T. W. Liao	Pittsfield, Mass.
K. N. Mathes	Schenectady, N. Y.
D. A. McLean	Murray Hill, N. J.
P. Robinson	North Adams, Mass.
A. W. Rogers	Fort Monmouth, N. J.
L. T. Russell	New York, N. Y.
A. H. Scott	Washington, D. C.
A. H. Sharbaugh	Schenectady, N. Y.
L. E. Sieffert	Washington, D. C.
Victor Siegfried	Worcester, Mass.
G. M. L. Sommerman	Columbus, Ohio
Joseph Sticher	Detroit, Mich.
C. R. Vail	Durham, N. C.

Working Group on Evaluation of Thermal Stability Of Insulating Materials

T. W. Dakin, *Chairman;* Westinghouse Elec. Corp. Research Lab., East Pittsburgh, Pa.

H. A. Adler	Chicago, Ill.
O. E. Anderson	Newark, Del.
E. L. Brancato	Washington, D. C.
E. J. Burrough	Wilmington, Del.
L. M. Conklin	Ashton, R. I.
T. W. Dexter	Midland, Mich.
R. K. Drake	Fort Wayne, Ind.
P. J. Franklin	Washington, D. C.
J. L. Fuller	Cleveland, Ohio
R. W. Hall	Fort Wayne, Ind.
G. T. Kohman	Murray Hill, N. J.
V. J. Kublin	Fort Monmouth, N. J.
J. L. Kuehlthau	Milwaukee, Wis.
C. B. Leape	East Pittsburgh, Pa.
J. R. Learn	Schenectady, N. Y.
R. H. Lindsey	Schenectady, N. Y.
E. L. Lotz	Irvington, N. J.
M. L. Manning	Canonsburg, Pa.
K. N. Mathes	Schenectady, N. Y.
J. S. Parkinson	Manville, N. J.
W. W. Satterlee	Sharon, Pa.
H. L. Saums	Muskegon, Mich.
A. H. Scott	Washington, D. C.
E. F. Seaman	Washington, D. C.
L. E. Sieffert	Washington, D. C.
G. M. L. Sommerman	Columbus, Ohio
T. R. Walters	Pittsfield, Mass.

Semi-Conductors & Transistors Subcommittee

W. C. Dunlap, *Chairman;* Research Lab., General Electric Co., Schenectady 5, N. Y.

S. J. Angello	Pittsburgh, Pa.
P. P. Beroza	Los Angeles, Calif.
R. G. Breckenridge	Washington, D. C.
E. M. Conwell	Bayside, N. Y.
P. P. Debye	Waltham, Mass.
K. Lark-Horovitz	Lafayette, Ind.
C. L. Rouault	Syracuse, N. Y.
W. D Rowe	East Pittsburgh, Pa.
J. N. Shive	Murray Hill, N. J.
D. H. Toth	St. Paul, Minn.
G. Warfield	Princeton, N. J.

Basic Concepts Subcommittee

V. P. Hessler, *Chairman;* Dept. of Elec. Engg., University of Illinois, Urbana, Ill.

W. G. Amey	Philadelphia, Pa.
S. B. Batdorf	E. Pittsburgh, Pa.
J. G. Brainerd	Philadelphia, Pa.
C. R. Cahn	Syracuse, N. Y.
G. B. Hoadley	Raleigh, N. C.
V. E. Legg	Murray Hill, N. J.
W. R. LePage	East Syracuse, N. Y.
M. G. Malti	Ithaca, N. Y.
Chester Peterson	Washington, D. C.
F. B. Silsbee	Washington, D. C.
J. J. Smith	Schenectady, N. Y.
D. W. Spence	Syracuse, N. Y.

Committee on Computing Devices

F. J. Maginniss, *Chairman;* Analytical Engg. Dept., General Electric Co., 1 River Road, Schenectady, N. Y.

E. L. Harder, *Vice-Chairman*	East Pittsburgh, Pa.
S. H. Dodd, Jr. *Secretary*	Lexington, Mass.
S. N. Alexander	Washington, D. C.
R. H. Benner	Moorestown, N. J.
J. G. Brainerd	Philadelphia, Pa.
J. F. Calvert	Pittsburgh, Pa.
W. G. Dow	Ann Arbor, Mich.
F. H. Ferguson	Washington, D. C.
Geroge Glinski	Ottawa, Ont., Canada
G. G. Hoberg	Philadelphia, Pa.
B. D. Holbrook	Murray Hill, N. J.
R. M. Kalb	St. Paul, Minn.
R. G. Lex, Jr.	Philadelphia, Pa.
J. L. C. Lof	Storrs, Conn.
W. H. MacWilliams, Jr.	Whippany, N. J.
J. W. Mauchly	Philadelphia, Pa.
G. D. McCann	Pasadena, Calif.
A. W. McCourt	Baltimore, Md.
J. C. McPherson	New York, N. Y.
A. L. Miller	Cleveland, Ohio
M. E. Mohr	Pacific Palisades, Calif.
P. L. Morton	Berkeley, Calif.
P. F. Ordung	New Haven, Conn.
J. A. Parrott	New York, N. Y.
Juergen Roedel	Hammond, Ind.
Stanley Rogers	San Diego, Calif.
Morris Rubinoff	Philadelphia, Pa.
J. D. Ryder	East Lansing, Mich.
V. G. Smith	Toronto, Ont., Canada
C. R. Wayne	Syracuse, N. Y.

Digital Computers Subcommittee

Morris Rubinoff, *Chairman;* Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia 4, Pa.

(*Personnel to be selected*)

Analog Computers Subcommittee

G. D. McCann, Jr., *Chairman;* Department of Electrical Engineering, California Institute of Technology, Pasadena 4, Calif.

(*Personnel to be selected*)

Computer Bibliography Subcommittee

J. W. Mauchly, *Chairman;* Eckert-Mauchly Division. Remington Rand, Inc., 2300 W. Allegheny Avenue, Philadelphia, Pa.

(*Personnel to be selected*)

Digital Computer Comparisons Subcommittee

W. H. MacWilliams, Jr., *Chairman;* Bell Telephone Laboratories, Inc., Whippany, N. J.

(*Personnel to be selected*)

Analog-Digital Converters Subcommittee

C. R. Wayne, *Chairman;* General Electric Company, Electronics Park, Syracuse, N. Y.

(*Personnel to be selected*)

West Coast Subcommittee

P. L. Morton, *Chairman;* Division of Electrical Engineering, University of California, Berkeley 4, Calif.

(*Personnel to be selected*)

Committee on Electrical Techniques in Medicine and Biology

E. D. Trout, *Chairman;* General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 1, Wis.

T. H. Rogers, *Vice-Chairman*	Springdale, Conn.
L. F. Ehrke, Secretary	Bloomfield, N. J.
G. D. Adams	San Francisco, Calif.
W. E. Barbour, Jr.	Boston, Mass.
G. W. Dunlap	Schenectady, N. Y.
W. A. Geohegan	New York, N. Y.
R. W. Gilbert	Newark, N. J.
S. R. Gilford	Washington, D. C.
J. P. Kelley	Milwaukee, Wis.
W. S. Lusby	Baltimore, Md.
G. E. Maxim	Cleveland, Ohio
L. H. Montgomery	Nashville, Tenn.
G. A. Morton	Princeton, N. J.
H. P. Schwan	Philadelphia, Pa.
S. W. Smith	Washington, D. C.
S. R. Warren, Jr.	Philadelphia, Pa.
R. E. Watson	Philadelphia, Pa.
A. M. Zarem	Los Angeles, Calif.

(No Subcommittees)

Committee on Electronics

H. C. Steiner, *Chairman;* General Electric Co., I & T Tube Sub-Dept., 1 River Road, Schenectady, N. Y.

J. D. Ryder, *Vice-Chairman*	East Lansing, Mich.
D. G. Wilson, *Secretary*	Lawrence, Kans.
W. R. G. Baker	Syracuse, N. Y.
E. A. Blomqvist	New York, N. Y.
E. M. Boone	Columbus, Ohio
C. J. Breitwieser	Santa Monica., Calif.
C. B. Brown	White Oak, Md.
R. S. Burnap	Harrison, N. J.
J. M. Cage	Lafayette, Ind.
A. H. Canada	Schenectady, N. Y.
R. C. Cheek	Baltimore, Md.
J. H. Clark	Los Angeles, Calif.
W. R. Clark	Philadelphia, Pa.
G. J. Crowdes	Cambridge, Mass.
W. G. Dow	Ann Arbor, Mich.
A. V. Eastman	Seattle, Wash.
W. T. Evans	Beaumont, Texas
Rudolf Feldt	Clifton, N. J.
G. H. Fett	Urbana, Ill.
D. G. Fink	Philadelphia, Pa.
H. L. Flowers	Akron, Ohio
Beardsley Graham	Phoenix, Ariz.
L. L. Grandi	Los Angeles, Calif.
H. W. Haase	Portland, Oreg.
A. A. Hagedorn	Culver City, Calif.
C. F. Hanson	Los Angeles, Calif.
Victor Harris	Silver Spring, Md.
Scott Helt	Clifton, N. J.
R. E. Higgs	Harrison, N. J.
J. E. Hobson	Stanford, Calif.
R. E. Hommel	Dayton, Ohio
A. J. Humphrey	Cleveland, Ohio
J. R. Hyneman	New York, N. Y.
W. H. Jensen	Baltimore, Md.
J. P. Jordan	Syracuse, N. Y.
T. P. Kinn	Baltimore, Md.
K. S. Koon	Endicott, N. Y.
O. W. Livingston	Schenectady, N. Y.
J. A. M. Lyon	Evanston, Ill.
D. E. Marshall	Elmira, N. Y.
V. V. Mason	Hamilton, Ont., Canada
S. T. Maunder	Holyoke, Mass.
C. F. McCabe	San Diego, Calif.
H. J. McCreary	Chicago, Ill.
H. R. Meahl	Schenectady, N. Y.
H. R. Mimno	Cambridge, Mass.
T. H. Morrin	Stanford, Calif.
G. A. Morton	Princeton, N. J.
J. B. Nayler	Isle Maligne, Que., Canada
B. K. Northrop	Ithaca, N. Y.
David Packard	Palo Alto, Calif.
F. W. Petit	Waterbury, Conn.
A. J. Quigley	Notre Dame, Ind.
J. G. Reid, Jr.	Alexandria, Va.
R. W. Reynolds	Jensen, Fla.
Walther Richter	Milwaukee, Wis.
E. T. Sherwood	Milwaukee, Wis.
S. W. Smith	Washington, D. C.
E. P. Spandau	Pasadena, Calif.
C. F. Spitzer	Syracuse, N. Y.
J. R. Steen	New York, N. Y.
N. T. Stone	St. Paul, Minn.
Milton Tenzer	Fort Monmouth, N. J.
D. E. Trucksess	New York, N. Y.
J. C. Van Arsdell, Jr.	Erie, Pa.
H. J. White	Bound Brook, N. J.
W. C. White	Schenectady, N. Y.
A. M. Zarem	Los Angeles, Calif.

Subcommittee on Electron Tubes

R. E. Higgs, *Chairman;* Radio Corporation of America, Harrison, New Jersey

D. S. Peck, *Secretary*	Allentown, Pa.
W. G. Dow	Ann Arbor, Mich.
D. V. Edwards	Newark, N. J.
Joseph Evon	Bath, N. Y.
R. C. Fortin	Harrison, N. J.
J. A. Goetz	Poughkeepsie, N. Y.
T. H. Haase	Portland, Oreg.
Scott Helt	Clifton, N. J.
J. H. Hutchings	Geneva, Ill.
E. O. Johnson	Princeton, N. J.
R. G. Lex	Philadelphia, Pa.
O. W. Livingston	Schenectady, N. Y.
C. R. Marcum	Newton Heights, Mass.
D. E. Marshall	Elmira, N. Y.
R. E. Pratt	Endicott, N. Y.
J. R. Roeder	East Pittsburgh, Pa.
August Schmidt, Jr.	Schenectady, N. Y.
J. R. Steen	New York, N. Y.
H. C. Steiner	Schenectady, N. Y.
W. B. Whalley	Brooklyn, N. Y.
Harold Winograd	Milwaukee, Wis.
H. H. Wittenberg	Lancaster, Pa.
J. F. Wilhelm	Lancaster, Pa.

Hot Cathode Converter Subcommittee

W. H. Bixby, *Chairman;* Elec. Engrg. Dept., Wayne University, Detroit, Mich.

J. H. Burnett	Newark, N. J.
R. P. Featherstone	Minneapolis, Minn.

A. J. Humphrey	Cleveland, Ohio
J. H. Hutchings	Geneva, Ill.
E. E. Moyer	Troy, N. Y.
D. H. Smith	New York, N. Y.
D. E. Trucksess	New York, N. Y.

Subcommittee on Infrared Applications

A. H. Canada, *Chairman;* General Electric Company, General Engineering & Consulting Lab., Schenectady, N. Y.

A. R. Bennett	Newport, R. I.
William A. Dynes	Dayton, Ohio
W. G. Fastie	Philadelphia, Pa.
B. J. Goldfarb	Dayton, Ohio
C. S. Woodside	Washington, D. C.
K. B. Adams	East Pittsburgh, Pa.

Subcommittee on Electrostatic Processes

H. J. White, *Chairman;* Research Corporation, 465 West Union Avenue, Bound Brook, N. J.

S. R. Orem, *Secretary*	Greenwich, Conn.
J. O. Amstuz	Troy, N. Y.
J. E. Coolidge	Bellwood, Ill.
J. W. Farr	Holyoke, Mass.
G. W. Hewitt	East Pittsburgh, Pa.
E. P. Miller	Indianapolis, Ind.
H. V. Nelson	Schenectady, N. Y.
G. W. Penny	Pittsburgh, Pa.
E. R. Thomas	New York, N. Y.

Subcommittee on High Frequency Conductors, Cables & Connectors

Milton Tenzer, *Chairman;* Squier Signal Laboratory, Fort Monmouth, New Jersey

G. J. Crowdes	Cambridge, Mass.
W. R. Dohan	Camden, N. J.
E. W. Greenfield	Spokane, Wash.
J. D. Heibel	Erie, Pa.
B. A. Jackson	New York, N. Y.
W. J. King	Murray Hill, N. J.
H. B. Slade	Passaic, N. J.
W. R. Thurston	New York, N. Y.

Subcommittee on Papers Review

W. C. White, *Chairman;* General Electric Company, Research Laboratory, The Knolls, Schenectady, N. Y.

H. F. Dart, *Vice-Chairman*	Elmira, N. Y.
R. S. Burnap	Harrison, N. J.
W. R. Clark	Philadelphia, Pa.
Rudolf Feldt	Clifton, N. J.
R. E. Graham	Kew Gardens, N. Y.
S. B. Ingram	Murray Hill, N. J.
L. A. Kilgore	East Pittsburgh, Pa.
H. L. Palmer	Schenectady, N. Y.
H. C. Steiner	Schenectady, N. Y.
Harold Winograd	Milwaukee, Wis.

Subcommittee on Electronic Circuits and Systems Engineering

H. L. Flowers, *Chairman;* Goodyear Aircraft Corporation, Akron, Ohio

Langford T. Bourland	Washington, D. C.
R. M. Combes	Burbank, Calif.
Victor Harris	Silver Spring, Md.
Allen B. Macnee	Ann Arbor, Mich.
J. F. Reintjes	Cambridge, Mass.
J. D. Ryder	Urbana, Ill.

Subcommittee on Industrial X Ray

R. F. Wilson, *Chairman;* General Electric Company, X-Ray Department, Milwaukee, Wis.

Z. J. Atlee	Chicago, Ill.
Arthur Klinckermann	Chicago, Ill.
Joseph Lempert	Bloomfield, N. J
G. E. Maxim	Cleveland, Ohio
T. H. Rogers	Springdale, Conn.
Scott Smith	Washington, D. C.
David Sussin	Covington, Ky.

Subcommittee on Education in Electronics

J. M. Cage, *Chairman;* Electrical School, Purdue University, Lafayette, Ind.

A. L. Albert	Corvallis, Oreg.
E. M. Boone	Columbus, Ohio
M. A. Honnell	Atlanta, Ga.
B. K. Northrup	Ithaca, N. Y.
A. J. Quigley	Notre Dame, Ind.
D. G. Wilson	Lawrence, Kans.

Subcommittee on Electronic Semi-Conductor Devices

J. P. Jordan, *Chairman;* General Electric Company, Electronics Laboratory Elctronics Park, Syracuse, N. Y.

C. A. Clarke	New York, N. Y.
R. L. Crosby	St. Paul, Minn.
F. M. Dukat	Newton, Mass.
R. S. Fallows	Boston, Mass.
H. Goldberg	Washington, D. C.
W. H. Hall	Syracuse, N. Y.
H. F. Heath	Poughkeepsie, N. Y.
J. R. Hyneman	New York, N. Y.
V. P. Mathis	Syracuse, N. Y.
H. Q. North	Culver City, Calif.
J. R. Roeder	East Pittsburgh, Pa.
C. L. Rouault	Syracuse, N. Y.
A. D. Rittmann	Philadelphia, Pa.

Subcommittee on Electronic Aids to Navigation

H. R. Mimno, *Chairman;* Cruft Laboratory, Harvard University, Cambridge 38, Mass.

Subcommittee on West Coast

B. S. Graham, *Chairman;* Stanford Research Institute, Mountain States Division, 204 Heard Bldg., Phoenix, Ariz.

(*Personnel to be selected*)

Liaison With JETEC Subcommittees

D. E. Marshall, *Chairman;* Westinghouse Electric Corp., P. O. Box 284, Elmira, N. Y.

Liaison With IRE Subcommittee

E. M. Boone, *Chairman;* Department of Electrical Engg., Ohio State University, Columbus, Ohio

R. S. Burnap	Harrison, N. J.
C. F. Spitzer	Syracuse, N. Y.
J. R. Steen	New York, N Y.

Liaison With Magnetic & Dielectric Amplifiers Committee

C. J. Breitweiser, *Chairman;* Lear, Inc., 3171 So. Bundy Drive, Santa Monica, Calif.

Gunnar Wennerberg	Santa Monica, Calif.

Liaison With Electronic Heating Subcommittee

T. P. Kinn, *Chairman;* 20 Oaklee Village, Baltimore 29, Md.

Liaison With Standards Subcommittee

C. H. Willis, *Chairman;* Princeton University, Princeton, N. J.

Liaison With Instruments & Measurements Committee

R. Feldt, *Chairman;* Federal Telephone & Radio Co., 100 Kingsland Road, Clifton, N. J.

Committee on Instruments & Measurements

J. G. Reid, Jr., *Chairman;* A.C.F. Electronics, 800 North Pitt Street, Alexandria, Va.

Ernst Weber, *Vice-Chairman (East)*	Brooklyn, N. Y.
W. S. Pritchett, *Vice-Chairman (West)*	Berkeley, Calif.
C. F. Savage, Jr., *Secretary*	West Lynn, Mass.
H. D. Barnhart	Erie, Pa.
S. C. Bartlett	New York, N. Y.
P. L. Bellaschi	Portland, Oreg.
H. W. Berry	Minneapolis, Minn.
J. R. Bird	Cleveland, Ohio
C. W. Boadway	Toronto, Ont., Canada
E. J. Bobyn	Quebec, Que., Canada
P. A. Borden	Waterbury, Conn.
G. L. Broomell	Philadelphia, Pa.
D. L. Brown	Portland, Oreg.
L. A. Burckmyer, Jr.	Ithaca, N. Y.
J. H. Chiles, Jr.	Sharon, Pa.
W. R. Clark	Philadelphia, Pa.
D. H. Clewell	Dallas, Texas
A. B. Craig	Boston, Mass.
E. B. Curdts	Philadelphia, Pa.
C. L. Dawes	Cambridge, Mass.
F. C. Doble	Belmont, Mass.
C. K. Duff	Toronto, Ont., Canada
I. G. Easton	Cambridge, Mass.
G. V. Eltgroth	Liverpool, N. Y.
Rudolf Feldt	Clifton, N. J.
J. G. Ferguson	Summit, N. J.
G. F. Gardner	Schenectady, N. Y.
T. S. Gray	Cambridge, Mass.
Ferdinand Hamburger, Jr.	Baltimore, Md.
F. K. Harris	Washington, D. C.
C. E. Hastings	Hampton, Va.
C. M. Hathaway	Denver, Colo.
J. E. Hobson	Stanford, Calif.
J. I. Holbeck	Portland, Oreg.
G. A. Holt	Oak Ridge, Tenn.
A. J. Hornfeck	Cleveland, Ohio
R. J. Jeffries	East Lansing, Mich.
A. K. Joecks	New York, N. Y.
R. V. Kelch	Canton, Ohio
Herman C. Koenig	New York, N. Y.
E. S. Lee	Schenectady, N. Y.
B. E. Lenehan	Newark, N. J.
G. S. Lunge	Schenectady, N. Y.
J. T. Lusignan, Jr.	Mansfield, Ohio
E. E. Lynch	West Lynn, Mass.
C. G. Mansfield	Los Angeles, Calif.
G. S. Marvin	Flint, Mich.
W. J. Mayo-Wells	Silver Spring, Md.
P. K. McElroy	Cambridge, Mass.
C. W. Miller	Norwalk, Conn.
J. H. Miller	Newark, N. J.
G. A. Morton	Princeton, N. J.
R. J. Parent	Madison, Wis.
A. J. Petzinger	Newark, N. J.
L. E. Rinker	Portland, Oreg.
F. A. Salmon	Corpus Christi, Texas
F. B. Silsbee	Washington, D. C.
W. P. Simpson	Schenectady, N. Y.
G. S. Smith	Seattle, Wash.
Harry Sohon	Philadelphia, Pa.
Carroll Stansbury	Bethesda, Md.
G. P. Stout	Baltimore, Md.
M. B. Stout	Ann Arbor, Mich.
F. J. Vogel	Milwaukee, Wis.
P. H. Ware	Cambridge, Mass.
W. A. Weiss	Cleveland, Ohio
R. E. Wendt, Jr.	East Pittsburgh, Pa.
E. L. White	Washington, D. C.
W. H. Wickham	Chicago, Ill.
D. G. Wilson	Lawrence, Kans.
A. H. Wing, Jr.	Evanston, Ill.
L. R. Yorgy	Lynn, Mass.

I. Group Subcommittee on General Activities

H. C. Koenig, *Chairman;* Electrical Testing Laboratories, Inc., 2 East End Avenue, New York 21, N. Y.

W. R. Clark	Philadelphia, Pa.
J. E. Clem	Schenectady, N. Y.
A. B. Craig	Boston, Mass.
C. L. Dawes	Cambridge, Mass.
H. C. Dickinson	West Lynn, Mass.
W. N. Goodwin, Jr.	Newark, N. J.
T. S. Gray	Cambridge, Mass.
J. E. Hobson	Stanford, Calif.
E. S. Lee	Schenectady, N. Y.
B. E. Lenehan	Newark, N. J.
J. H. Miller	Newark, N. J.
J. G. Reid, Jr.	Alexandria, Va.
C. F. Savage, Jr.	West Lynn, Mass.
F. B. Silsbee	Washington, D. C.
Ernst Weber	Brooklyn, N. Y.

A. *Subcommittee on Organization*

T. S. Gray, *Chairman;* Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

W. R. Clark
J. E. Hobson
E. S. Lee
J. H. Miller
J. G. Reid, Jr.
C. F. Savage, Jr.
Ernst Weber

B. *Subcommittee on Definitions*

C. L. Dawes, *Chairman;* Harvard University, Pierce Hall, Cambridge 39, Mass.

J. E. Clem
A. B. Craig
H. C. Dickinson
W. N. Goodwin, Jr.
B. E. Lenehan
F. B. Silsbee

C. *Subcommittee on Co-operation with Instruments Society of America*

T. L. Mell, *Chairman;* Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

D. *Representatives on Other Committees*

1. Standards Committee: H. C. Koenig

II. Group Subcommittee on Indicating and Integrating Instruments

J. H. Miller, *Chairman;* Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

S. C. Bartlett	New York, N. Y.
J. R. Bird	Cleveland, Ohio
D. L. Brown	Portland, Oreg.
L. A. Burckmyer, Jr.	Ithaca, N. Y.
G. N. Burkhart, Jr.	Lafayette, Ind.
D. T. Canfield	Lafayette, Ind.
A. H. Christie	Baltimore, Md.
A. B. Craig	Boston, Mass.
W. C. Downing	Springfield, Ill.
J. L. Fuller	Cleveland, Ohio
F. K. Harris	Washington, D. C.
A. K. Joecks	New York, N. Y.
R. V. Kelch	Canton, Ohio
W. G. Knickerbocker	Detroit, Mich.
H. C. Koenig	New York, N. Y.
B. E. Lenehan	Newark, N. J.
W. N. Lindblad	Emeryville, Calif.
C. G. Mansfield	Los Angeles, Calif.
L. W. Matsch	Chicago, Ill.
F. H. Rogers	Baltimore, Md.
F. A. Salmon	Corpus Christi, Texas
C. F. Savage, Jr.	West Lynn, Mass.
G. S. Smith	Seattle, Wash.
Harry Sohon	Philadelphia, Pa.
K. M. Stevens	Alhambra, Calif.
L. N. Stone	Corvallis, Oreg.
G. P. Stout	Baltimore, Md.
M. B. Stout	Ann Arbor, Mich.
J. M. Vanderleck	Toronto, Ont., Canada
Ernst Weber	Brooklyn, N. Y.
W. A. Weiss	Cleveland, Ohio
D. G. Wilson	Lawrence, Kansas

A. *Subcommittee on Indicating Instruments*

F. K. Harris, *Chairman;* Electricity Division, National Bureau of Standards, Washington 25, D. C.

C. G. Mansfield Los Angeles, Calif.

B. *Subcommittee on Watthour Meters*

B. E. Lenehan, *Chairman;* Engineering Department, Westinghouse Electric Corporation, 95 Orange Street, Newark 1, N. J.

H. A. Brown
G. N. Burkhart, Jr.
D. T. Canfield
A. B. Craig
W. C. Downing
W. G. Knickerbocker
H. C. Koenig
W. N. Lindblad
F. H. Rogers
C. F. Savage, Jr.
K. M. Stevens
M. B. Stout
J. M. Vanderleck

C. *Subcommittee on Master Test Code for Power Measurements*

J. H. Miller, *Chairman;* Weston Electrical Instrument Corp., 614 Frelinghuysen Avenue, Newark 5, N. J.

A. H. Christie
J. L. Fuller
A. K. Joecks
W. G. Knickerbocker
H. C. Koenig
B. E. Lenehan
L. W. Matsch
C. F. Savage, Jr.
Harry Sohon
L. N. Stone

D. *Representatives on Other Committees*

1. *ASA Revision of C-39.1:* H. C. Koenig, Electrical Testing Laboratories, Inc., 2 East End Avenue, New York 21, N. Y.
2. *ASME Power Test Code:* A. K. Joecks, Consolidated Edison Company of New York, Inc., 708 First Avenue, New York 3, N. Y.

III. Group Subcommittee on Recording and Controlling Instruments

G. L. Broomell, *Chairman;* Leeds & Northrup Company, 4901 Stenton Avenue., Philadelphia 44, Pa.

E. F. Adams	Newark, N. J.
P. A. Borden	Waterbury, Conn.
W. R. Clark	Philadelphia, Pa.
J. G. Ferguson	Murray Hill, N. J.
G. F. Gardner	Schenectady, N. Y.
Albert Hansen, Jr.	West Lynn, Mass.
C. M. Hathaway	Denver, Colo.
G. A. Holt	Oak Ridge, Tenn.
A. J. Hornfeck	Cleveland, Ohio
W. H. Howe	Foxboro, Mass.
R. J. Jeffries	East Lansing, Mich.
H. C. Koenig	New York, N. Y.
J. W. Percy	Kearny, N. J.
T. H. Pierson	Corpus Christi, Texas
F. A. Ransom	Alexandria, Va.
W. A. Stelzer	Midland, Mich.
J. M. Vanderleck	Toronto, Ont., Canada
W. G. Walker	Philadelphia, Pa.
R. F. Wild	Wilmington, Del.

A. *Subcommittee on Recording and Controlling Instruments*

G. L. Broomell, *Chairman;* Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia 44, Pa.

E. F. Adams
P. A. Borden
J. G. Ferguson
Albert Hansen, Jr.
A. J. Hornfeck
W. H. Howe
R. J. Jeffries
H. C. Koenig
J. W. Percy
T. H. Pierson
F. A. Ransom
W. A. Stelzer
J. M. Vanderleck
W. G. Walker
R. F. Wild

B. *Representatives on Other Committees*

1. *ASA Revision of C-39-2:* H. C. Koenig, Electrical Testing Laboratories, Inc., 2 East End Avenue, New York 21, N. Y.
2. *ASME Industrial Instruments and Regulators:* G. F. Gardner, General Engineering Laboratory, General Electric Company, 1 River Road, Schenectady 5, N. Y.
3. *Feedback Control Systems:* J. G. Ferguson, Bell Telephone Laboratories, Inc., Summit, N. J.

IV. Group Subcommittee on Electronic and High-Frequency Instruments

Rudolph Feldt, *Chairman;* Instrument Division, Federal Telephone & Radio Co., 100 Kingsland Road, Clifton, N. J.

M. J. Ackerman	Camden, N. J.
G. E. Beggs, Jr.	Philadelphia, Pa.
E. D. Bobyn	Quebec City, Que., Canada
C. C. Chambers	Philadelphia, Pa.
H. F. Dart	Elmira, N. Y.
Edward Durbin	Great Neck, N. Y.
I. G. Easton	Cambridge, Mass.
G. V. Eltgroth	Norwalk, Conn.
W. A. Erskine	Alhambra, Calif.
R. G. Fellers	Washington, D. C.
T. S. Gray	Cambridge, Mass.
M. L. Greenough	Washington, D. C.
E. R. Haberland	Silver Spring, Md.
Ferdinand Hamburger, Jr.	Baltimore, Md
C. E. Hastings	Hampton, Va.
C. M. Hathaway	Denver, Colo.
R. K. Hellman	Little Neck, N. Y.
D. M. Hill	Boonton, N. J.
G. B. Hoadley	Raleigh, N. C.
G. A. Holt	Oak Ridge, Tenn.
J. W. Kearney	Mineola, N. Y.
Harold Lyons	Washington, D. C.
G. S. Marvin	Flint, Mich.
N. W. Matthews	Washington, D. C.
H. R. Meahl	Schenectady, N. Y.
P. K. McElroy	Cambridge, Mass.
Edmund Osterland	Boonton, N. J.
T. P. Perkins	Harrison, N. J.
D. C. Ports	Washington, D. C.
E. R. Thomas	New York, N. Y.
Howard Vollum	Portland, Oreg.
A. H. Waynick	State College, Pa.
Ernst Weber	Brooklyn, N. Y.
W. P. Wills	Philadelphia, Pa.
A. H. Wing, Jr.	Evanston, Ill.

A. *Subcommittee on High-Frequency Instruments*

Ferdinand Hamburger, Jr., *Chairman;* Department of Electrical Engineering, Johns Hopkins University, Homewood, Baltimore 18, Md.

W. A. Erskine
R. G. Fellers
R. K. Hellmann
J. W. Kearney
Harold Lyons
H. R. Meahl
D. C. Ports
Ernst Weber
A. H. Wing, Jr.

B. *Subcommittee on Electronic Instruments*

P. K. McElroy, *Chairman;* General Radio Corp., Cambridge, Mass.

M. J. Ackerman
G. E. Beggs, Jr.
C. C. Chambers
H. F. Dart
Edward Durbin
G. V. Eltgroth
Rudolf Feldt
M. L. Greenough
E. R. Haberland
C. E. Hastings
C. M. Hathaway
D. M. Hill
G. B. Hoadley
N. W. Matthews
Edmund Osterland
T. P. Perkins
E. R. Thomas
Howard Vollum
A. H. Waynick
W. P. Wills

C. *Representatives on Other Committees*

1. *Standard Frequency Bands and Designations:* I. G. Easton, General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Mass.
2. *AIEE Computing Devices Committee:* G. V. Eltgroth, Remington Rand, Inc., 315 4th Ave., New York, N. Y.
3. *AIEE-IRE Noise Definitions Committee:* I. G. Easton, Cambridge, Mass.
4. *ASA Subcommittee C-63 on Noise Measurement:* I. G. Easton, Cambridge, Mass.
5. *Electronics Committee:* Rudolf Feldt, Federal Telephone & Radio Co., Clifton, N. J.

V. Group Subcommittee on Special Instruments and Auxiliary Apparatus

Harry Sohon, *Chairman;* Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia 4, Pa.

H. D. Barnhart	Erie, Pa.
H. M. Bedell	Cleveland, Ohio
J. H. Chiles, Jr.	Sharon, Pa.
R. M. Chapman	Cambridge, Mass.
G. L. Crumrine	Wilmington, Del.
E. B. Curdts	Philadelphia, Pa.
F. C. Doble	Belmont, Mass.
E. A. Elge	Pittsfield, Mass.
Rudolf Feldt	Clifton, N. J.
J. G. Ferguson	Murray Hill, N. J.
C. M. Foust	Schenectady, N. Y.
H. A. Frey	Baltimore, Md.
J. H. Hagenguth	Pittsfield, Mass.
J. I. Holbeck	Portland, Ore.
H. J. Klumb	Rochester, N. Y.
B. E. Lenehan	Newark, N. J.
G. S. Lunge	Schenectady, N. Y.
J. T. Lusignan, Jr.	Mansfield, Ohio
L. W. Matsch	Chicago, Ill.
G. D. McCann, Jr.	Pasadena, Calif.
C. W. Miller	Norwalk, Conn.
Norman Oliver	Cambridge, Mass.
R. J. Parent	Madison Wis.
J. C. Parker	Memphis, Tenn.
W. P. Simpson	Schenectady, N. Y.
G. S. Smith	Seattle, Wash.
C. S. Sprague	Lafayette, Ind.
Carroll Stansbury	Washington, D. C.
E. B. Stover, Jr.	Tulsa, Okla.
F. J. Vogel	Milwaukee, Wis.
P. H. Ware	Cambridge, Mass.
W. H. Wickham	Chicago, Ill.
D. G. Wilson	Lawrence, Kans.
S. W. Zimmerman	Ithaca, N. Y.

A. *Subcommittee on General Spectroscopy*

C. W. Miller, *Chairman;* Perkins Elmer Corp., Main Avenue, Norwalk, Conn.

H. M. Bedell
Robert Chapman
D. K. Coles
C. H. Corliss
H. M. Crosswhite
G. L. Crumrine
J. W. Enns
W. T. Gray
Norman Oliver
Jacob Sherman
John Sterner

B. *Subcommittee on Dielectric Measurements in the Field*

E. B. Curdts, *Chairman;* James G. Biddle Co., 1316 Arch Street, Philadelphia, Pa.

W. H. Wickham, *Vice-Chairman*
R. J. Alke
W. G. Amey
A. W. W. Cameron
F. C. Doble
C. A. Duke
W. F. Dunkle
I. G. Easton
E. A. Elge
H. S. Endicott
G. L. Hill
J. S. Johnson
J. L. Kuehlthau
J. H. McWhirter
R. L. Murray
F. S. Oliver
J. C. Parker
Andrew Pletenik
W. S. Price
C. W. Ross
E. L. Schlottere
O. E. Stamm
K. M. Stevens
P. H. Ware

C. *Subcommittee on Revision of Standard No. 4. (Measurement of Test Voltage in Dielectric Tests) ASA C-68.1*

J. T. Lusignan, Jr., *Chairman;* The Ohio Brass Company, 380 N. Main Street, Mansfield, Ohio

P. L. Bellaschi
J. S. Carroll
J. J. Clark, Jr.
J. E. Clem
E. W. Davis
C. M. Foust
H. A. Frey
M. Getting, Jr.
I. W. Gross
J. H. Hagenguth
W. B. Kouwenhoven
W. W. Lewis
G. D. McCann, Jr.
Morris Newman
J. H. Park
W. C. Sealey
C. S. Sprague
W. L. Teague
W. H. Wickham
S. W. Zimmerman

D. *Subcommittee on Instrument Accessories*

W. P. Simpson, *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

J. H. Chiles, Jr.
C. M. Foust
J. I. Holbeck
J. G. Ferguson
G. D. McCann
G. S. Smith

E. *Subcommittee on Master Test Code for Rotary Speed Measurements*

Carroll Stansbury, *Chairman;* National Bureau of Standards, Washington 25, D. C.

I. G. Easton
J. L. Fuller
B. E. Lenehan
H. T. Rights
Harry Sohon

F. Subcommittee on Geophysical Instruments and Measurements

D. H. Clewell
Rudolf Feldt
E. B. Stover
D. G. Wilson

G. Representatives on Other Committees

1. *ASA C-57 Instrument Transformers:* J. H. Chiles, Jr., Westinghouse Electric Corp., 469 Sharpsville Ave., Sharon, Pa.
2. *Subcommittee on Test-Insulated Conductors:* P. H. Ware, Simplex Wire & Cable Co., 79 Sidney St., Cambridge 39, Mass.
3. *Subcommittee on Insulating Fluids:* F. C. Doble, Doble Engineering Company, 32 Locust Street, Belmont, Mass.
4. *AIEE Transformer Committee:* J. H. Chiles, Jr., Westinghouse Electric Corp., 469 Sharpsville Ave., Sharon, Pa.
5. *Committee on Electric Welding (Subcommittee on Resistance Welding Instrumentation):* to be selected
6. *Carrier Current Liaison:* G. S. Lunge, General Electric Co., Central Station Engg. Div., Schenectady 5, N. Y.
7. *Transformer Test Code Subcommittee:* F. J. Vogel, Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

VI. Group Subcommittee on Telemetering

E. E. Lynch, *Chairman;* General Electric Company, 40 Federal Street, West Lynn, Mass.

G. M. Thynell, *Vice-Chairman*	Silver Spring, Md.
J. L. Blackburn, *Secretary*	Newark, N. J.
E. F. Adams	Newark, N. J.
E. J. Bobyn	Quebec, Canada
P. A. Borden	Waterbury, Conn.
M. A. Bostwick	Portland, Oreg.
J. F. Brinster	Princeton, N. J.
Hezzie Clark	Houston, Texas
W. A. Clark	New York, N. Y.
R. E. Colander	Burbank, Calif.
W. A. Derr	East Pittsburgh, Pa.
J. A. Doremus	Plainville, Conn.
C. K. Duff	Toronto, Ont., Canada
R. L. Harding	Mishawaka, Ind.
C. H. Hoeppner	Newton, Mass.
A. J. Hornfeck	Cleveland, Ohio
M. V. Kiebert, Jr.	Indianapolis, Ind.
R. K. Klumb	Los Angeles, Calif.
G. S. Lunge	Schenectady, N. Y.
C. A. Mabey	Newark, N. J.
W. J. Mayo-Wells	Silver Spring, Md.
I. S. Mendenhall	Detroit, Mich.
M. G. Pawley	Corona, Calif.
J. W. Peckham	Los Angeles, Calif.
W. E. Phillips	Philadelphia, Pa.
W. E. Rufleth	Waterbury, Conn.
G. P. Stout	Baltimore, Md.
Paul Taylor	Corpus Christi, Texas
R. J. Trumbull	New York, N. Y.
F. L. Verwiebe	Silver Spring, Md.
G. F. C. Weedon	Toronto, Ont., Canada
W. A. Wildhack	Washington, D. C.
W. H. Worsham	Los Angeles, Calif.

A. Subcommittee on Stationary Telemetering Activities

P. A. Borden, *Chairman;* The Bristol Company, Waterbury 20, Conn.

E. F. Adams
J. L. Blackburn
M. A. Bostwick
Hezzie Clark
W. A. Clark
W. A. Derr
J. A. Doremus
C. K. Duff
A. J. Hornfeck
M. V. Kiebert, Jr.
R. K. Klumb
G. S. Lunge
E. E. Lynch
C. A. Mabey
W. J. Mayo-Wells
I. F. Mendenhall
J. W. Peckham
W. E. Phillips
W. E. Rufleth
Paul Taylor
G. M. Thynell
R. J. Trumbull
W. H. Worsham

B. Subcommittee on Mobile Telemetering Activities

W. J. Mayo-Wells, *Chairman;* Applied Physics Laboratory, Johns Hopkins University, 9900 Georgia Avenue, Silver Spring 18, Md.
(Personnel same as in *A* above including E. J. Bobyn and P. A. Borden, omitting W. E. Rufleth and W. H. Worsham)

C. Joint Subcommittee on Telemetering Terminology

W. J. Mayo-Wells, *Chairman*
J. L. Blackburn
P. A. Borden
J. F. Brinster
R. E. Colander
R. L. Harding
C. H. Hoeppner
M. V. Kiebert, Jr.
E. E. Lynch
M. G. Pawley
W. E. Phillips
G. M. Thynell
F. L. Verwiebe
G. F. C. Weedon
W. A. Wildhack

D. Subcommittee on Telemetering Bibliography

C. A. Mabey, *Chairman;* Weston Electrical Instrument Corp., 614 Frelinghuysen Avenue, Newark 5, N. J.

E. Subcommittee on Telemetering Aspects of Recorders and Control Instruments

A. J. Hornfeck, *Chairman;* Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio

F. Subcommittee for Revision of the 1948 Report "Telemetering, Supervisory Control, and Associated Circuits"

E. E. Lynch, *Chairman;* General Electric Co., 40 Federal Street, West Lynn, Mass.

P. A. Borden
W. A. Clark
C. K. Duff
G. S. Lunge
W. J. Mayo-Wells
I. S. Mendenhall
R. W. Ralston

(1) Subcommittee on Telemetering Section of Report Revision

W. J. Mayo-Wells, *Chairman;* Applied Physics Laboratory, Johns Hopkins University, 9900 Georgia Avenue, Silver Spring 18, Md.

J. L. Blackburn
P. A. Borden
J. A. Doremus
C. K. Duff
C. H. Hoeppner
A. J. Hornfeck
W. E. Phillips
Paul Taylor
G. M. Thynell

(2) Subcommittee on Supervisory Control Section of Report Revision

W. A. Clark, *Chairman;* American Tel. & Tel. Co., 195 Broadway, New York, N. Y.

Herman Bany
P. A. Borden
J. F. Bracken
H. W. Buss
G. E. Dana
W. A. Derr
W. H. Lawson
G. S. Lunge
M. Thrasher
K. L. Wheeler

(3) Subcommittee on Channels and Associated Circuits of Report Revision

R. W. Ralston, *Chairman;* American Tel. & Tel. Co., 195 Broadway, New York 7, N. Y.

F. S. Beale
J. A. Doremus
L. G. Eaton
H. B. Heckman
F. B. Hetherington
G. S. Lunge
E. A. Steere
L. G. Walker

G. Papers and Articles Subcommittee

W. J. Mayo-Wells, *Chairman;* Applied Physics Laboratory, Johns Hopkins University, 9900 Georgia Avenue, Silver Spring 18, Md.
W. E. Phillips (*Prize Papers*)

Liaison Representatives:

A. J. Hornfeck —AIEE & ISA Recorder and Chart Instrument
C. K. Duff —AIEE & ISA *C42* Group *30* Definitions
K. L. Wheeler —AIEE Substations Committee
M. V. Kiebert, Jr.—IRE Professional Group on Telemetering and Remote Control; IAS Electronics Committee
G. M. Thynell —Telemetering in Sweden
W. J. Mayo-Wells—Telemetering in Great Britain
J. L. McKee —AIEE Automatic and Supervisory Control Subcommittee of Substations Committee
G. S. Lunge —AIEE I & M Committee AIEE Carrier Current Committee
E. E. Lynch —AIEE Nucleonics Committee
Not assigned —AIEE Group Subcommittee on Navigation Instruments
Not assigned —AIEE Group Subcommittee on Radiation Instruments
A. J. Hornteck —ASME Industrial Instruments & Regulators
W. E. Phillips —Aspects of Telemetering Relating to Load Frequency Control

VII. Group Subcommittee on Nucleonic and Radiation Instruments

G. A. Morton, *Chairman;* R.C.A. Laboratories, Radio Corporation of America, Princeton, N. J.

R. L. Butenhoff	Washington, D. C.
D. L. Collins	Cleveland, Ohio
L. Costrell	Washington, D. C.
R. W. Johnston	Washington, D. C.
M. A. Schultz	Pittsburgh, Pa.
W. W. Schultz	Schenectady, N. Y.

A. Joint Subcommittee on Nucleonic Instruments

G. A. Morton, *Chairman*
(Personnel same as in VII above)

VIII. Group Subcommittee on Navigation Instruments

Chairman to be selected

A. Subcommittee for Air Navigation Instruments

Chairman to be selected

B. Subcommittee for Marine Navigation Instruments

Chairman to be selected

Committee on Magnetic Amplifiers

W. J. Dornhoefer, *Chairman;* Regulator Equipment Corp., 56 California Ave., Paterson 3, N. J.

H. W. Lord, *Vice-Chairman*	Schenectady, N. Y.
A. B. Haines, *Secretary*	Murray Hill, N. J.
A. O. Black, Jr.	Butler, Pa.
L. W. Buechler	St. Louis, Mo.
David Feldman	Brooklyn, N. Y.
W. J. Field	St. Paul, Minn.
L. A. Finzi	Pittsburgh, Pa.
W. A. Geyger	Silver Spring, Md.
J. E. Hart	Washington, D. C.
W. F. Horton	Pittsburgh, Pa.
R. E. Hull	Buffalo, N. Y.
W. C. Johnson	Princeton, N. J.
Alfred Krausz	Downey, Calif.
F. S. Malick	Milwaukee, Wis.
H. M. Ogle	Schenectady, N. Y.
R. A. Ramey	Pittsburgh, Pa.
P. L. Schmidt	Murray Hill, N. J.
R. M. Smith	Erie, Pa.
C. F. Spitzer	Syracuse, N. Y.
H. F. Storm	Schenectady, N. Y.
E. V. Weir	Butler, Pa.

Standards & Test Codes Subcommittee

J. E. Hart, *Chairman;* Naval Research Lab., Code 5560 Washington 25, D. C.

L. W. Buechler	Kirkwood, Mo.
W. J. Field	St. Paul, Minn.
L. A. Finzi	Pittsburgh, Pa.
R. E. Hull	Buffalo, N. Y.
H. L. Kellogg	Fort Wayne, Ind.
H. M. Ogle	Schenectady, N. Y.
P. H. Trickey	St. Louis, Mo.
T. G. Wilson	Butler, Pa.

Dielectric Amplifiers Subcommittee

C. F. Spitzer, *Chairman;* General Electric Co., Electronics Park, Syracuse, N. Y.

C. J. Breitwieser	Indianapolis, Ind.
Herman Epstein	Philadelphia, Pa.
L. A. Finzi	Pittsburgh, Pa.
C. A. Rosen	Syracuse, N. Y.
B. R. Shepard	Schenectady, N. Y.

Magnetic Amplifier Theory Subcommittee

W. C. Johnson, *Chairman;* Princeton University, School of Engineering, Princeton, N. J.

P. W. Barnhart	White Oak, Md.
W. J. Dornhoefer	Paterson, N. J.
David Feldman	Union, N. J.
L. A. Finzi	Pittsburgh, Pa.
A. B. Haines	Murray Hill, N. J.
A. M. Hopkin	Evanston, Ill.
H. W. Lord	Schenectady, N. Y.
R. A. Ramey	East Pittsburgh, Pa.
E. J. Smith	Brooklyn, N. Y.
H. F. Storm	Schenectady, N. Y.
W. H. Surber	Princeton, N. J.
T. G. Wilson	Butler, Pa.

West Coast Subcommittee

Alfred Frausz, *Chairman;* North American Aviation, Inc., 12214 Lakewood Blvd., Downey, Calif.

W. W. Bullock	Lawndale, Calif.
A. S. Fitzgerald	San Francisco, Calif.
J. J. Halloran	Oakland, Calif.
K. D. Johanson	Seattle, Wash.
H. E. Nylander, Jr.	Los Angeles, Calif.
A. B. Rosenstein	Los Angeles, Calif.
R. R. Selin	Pasadena, Calif.
S. H. White	Seattle, Wash.
Hugo Woerdeman	El Segundo, Calif.

Applications Subcommittee

W. F. Horton, *Chairman;* Materials Engg. Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

K. A. Benjamin	Cleveland, Ohio
Jerome Bentkowsky	Great Neck, N. Y.
L. W. Buechler	Kirkwood, Mo.

A. B. Haines	Murray Hill, N. J.
R. E. Hull	Buffalo, N. Y.
H. M. Ogle	Schenectady, N. Y.
H. S. Sechrist	Schenectady, N. Y.
R. M. Smith	Erie, Pa.
F. G. Timmel	Baltimore, Md.
E. V. Weir	Butler, Pa.

Definitions Subcommittee

A. B. Haines, *Chairman;* Bell Telephone Lab., Murray Hill, N. J.

P. W. Barnhart	White Oak, Md.
David Feldman	Union, N. J.
W. J. Field	St. Paul, Minn.
L. A. Finzi	Pittsburgh, Pa.
H. W. Lord	Schenectady, N. Y.
F. S. Malieck	Milwaukee, Wis.
D. G. Scorgie	Washington, D. C.
Philip Siskind	Great Neck, N. Y.
H. F. Storm	Schenectady, N. Y.
G. L. Sullivan	Lynn, Mass.
J. R. Walker	Detroit, Mich.
E. V. Weir	Butler, Pa.
R. M. Wundt	Dayton, Ohio

Materials Subcommittee

P. L. Schmidt, *Chairman;* Deerfield Road, Whippany, N. J.

A. O. Black	Butler, Pa.
W. C. Bullock	Baltimore, Md.
J. R. Conrath	St. Louis, Mo.
E. A. Gaugler	Butler, Pa.
H. A. Goldsmith	New York, N. Y.
E. A. Harty	Marblehead, Mass.
E. W. Lehtonen	Great Neck, N. Y.
F. J. Lingel	Syracuse, N. Y.
M. F. Littman	Middletown, Ohio
H. W. Lord	Schenectady, N. Y.
V. J. Louden	Schenectady, N. Y.
J. E. Mitch	Marengo, Ill.
G. F. Pittman	Pittsburgh, Pa.
W. T. Sackett, Jr.	Columbus, Ohio
W. F. Schmidt, Jr.	St. Louis, Mo.
D. G. Scorgie	Washington, D. C.
D. J. Sikorra	Minneapolis, Minn.
E. J. Smith	Brooklyn, N. Y.
F. G. Timmel	Baltimore, Md.

Committee on Metallic Rectifiers

Glen Ramsey, *Chairman;* Fansteel Metallurgical Corp., Rectifier-Capacitor Div., North Chicago, Ill.

D. E. Trucksess, *Vice-Chairman*	New York, N. Y.
E. A. Harty, *Secretary*	West Lynn, Mass.
S. J. Angello	Pittsburgh, Pa.
W. F. Bonner	Clifton, N. J.
P. R. Brown	Hamilton, Ont., Canada
L. W. Burton	Lynn, Mass.
P. G. Cobb	Newark, N. J.
W. F. Eagan	Milwaukee, Wis.
Joseph Gramels	New York, N. Y.
C. E. Hamann	Lynn, Mass.
L. K. Hedding	Pittsburgh, Pa.
C. C. Herskind	Schenectady, N. Y.
L. W. Morton	Schenectady, N. Y.
J. F. O'Donnell	Endicott, N. Y.
Bruce Seddon	Schenectady, N. Y.
I. R. Smith	Buffalo, N. Y.
P. H. Trickey	St. Louis, Mo.
R. A. Waite	New York, N. Y.
H. P. Weirich	Milwaukee, Wis.

Technical Information Subcommittee

C. E. Hamann, *Chairman;* General Electric Co., Rectifier Div., 920 Western Avenue, Lynn, Mass.

Joseph Gramels	New York, N. Y.
L. K. Hedding	Pittsburgh, Pa.
J. F. O'Donnell	Endicott, N. Y.

Instrument Rectifiers Subcommittee

P. G. Cobb, *Chairman;* Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Standards Subcommittee

I. R. Smith, *Chairman;* Westinghouse Elec. Corp., Motor Engg. Dept., Box 2025, Buffalo, N. Y.

W. F. Bonner	Clifton, N. J.
C. K. Hooper	Baltimore, Md.

Bibliography Subcommittee

E. A. Harty, *Chairman;* Rectifier Engg. Div., General Electric Co., River Works, West Lynn 3, Mass.

Patents Subcommittee

H. P. Weirich, *Chairman;* Fansteel Metallurgical Corp., 2609 West National Avenue, Milwaukee, Wis.

Papers & Speakers Subcommittee

L. W. Burton, *Chairman;* General Electric Co., River Works, 920 Western Avenue, Lynn, Mass.

L. K. Hedding	Pittsburgh, Pa.
J. F. O'Donnell	Endicott, N. Y.

Semi-Conductors (Rectifying Devices) Subcommittee

S. J. Angello, *Chairman;* Westinghouse Electric Corp., 7325 Penn Ave., Pittsburgh, Pa.

A. C. English	
G. Halverson	
H. W. Henkels	Pittsburgh, Pa.

Metallic Rectifiers for Magnetic Amplifiers Subcommittee

Bruce Seddon, Jr., *Chairman;* General Electric Co., Bldg. 37, Room 523, Schenectady, N. Y.

W. F. Eagan	Milwaukee, Wis.
P. H. Trickey	St. Louis, Mo.

Germanium Rectifiers Subcommittee

E. A. Harty, *Chairman;* Rectifier Engg. Div., General Electric Co. River Works, West Lynn 3, Mass.

Power Rectifiers Subcommittee

L. W. Morton, *Chairman;* General Electric Co., Power Electronics Division, Schenectady 5, N. Y.

Glen Farnsworth	Denver, Colo.
Joseph Gramels	New York, N. Y.
R. A. Waite	New York, N. Y.

Publicity Subcommittee

D. E. Trucksess, *Chairman;* Bell Telephone Labs., Inc., 463 West Street, New York 14, New York

Committee on Nucleonics

W. E. Barbour, Jr., *Chairman;* Tracerlab Inc., 130 High St., Boston 10, Mass.

P. N. Ross, *Vice-Chairman*	Pittsburgh, Pa.
T. S. Gray, *Secretary*	Cambridge, Mass.
H. W. Bibber	Schenectady, N. Y.
Philip Bliss	East Hartford, Conn.
H. W. Brackney	Silver Spring, Md.
D. W. Cardwell	Oak Ridge, Tenn.
V. S. Carson	Raleigh, N. C.
J. O'R. Coleman	Boston, Mass.
W. J. Dowis	Richland, Wash.
G. W. Dunlap	Schenectady, N. Y.
G. M. Farly	Berkeley, Calif.
H. J. Gomberg	Ann Arbor, Mich.
J. G. Hutton	Schenectady, N. Y.
T. R. Kohler	Irvington-on-Hudson, N. Y.
Lester Kornblith, Jr.	Chicago, Ill.
J. V. Kresser	San Francisco, Calif.
C. V. Larrick	Schenectady, N. Y.
R. G. Lorraine	Schenectady, N. Y.
E. E. Lynch	West Lynn, Mass.
G. A. Morton	Princeton, N. J.
M. S. Oldacre	Palo Alto, Calif.
J. K. Pickard	Washington, D. C.
Walther Richter	Milwaukee, Wis.
J. M. Schamberger	Bridgeport, Conn.
W. E. Shoupp	Pittsburgh, Pa.
J. G. Trump	Cambridge, Mass.
J. C. Weber	Madison, Wis.
W. F. Westendorp	Schenectady, N. Y.
R. F. Wilson	Milwaukee, Wis.
R. L. Witzke	McKeesport, Pa.

Nuclear Machines Subcommittee

J. G. Hutton, *Chairman;* General Electric Co., 1 River Road, Schenectady, N. Y.

(*Personnel to be selected*)

Application of Nuclear Reactors to the Production of Power Subcommittee

P. N. Ross, *Chairman;* Atomic Power Div., Westinghouse Electric Corp., Bettis Field, P. O. Box 1468, Pittsburgh, Pa.

(*Personnel to be selected*)

Nucleonics and Radiation Instruments Joint Subcommittee

G. A. Morton, *Chairman;* R.C.A. Laboratories, Inc., Princeton, N. J.

(*Personnel to be selected*)

West Coast Subcommittee

Abe Tilles, *Chairman;* Pacific Gas & Electric Co., 245 Market Street, 11th fl., San Francisco 6, Calif.

(*Personnel to be selected*)

Joint Subcommittees

Joint Subcommittee on Application of Probability Methods to Power System Problems (Joint with Power Generation and System Engineering Committees)

G. Calabrese, *Chairman;* Electrical Engineering Dept., New York University, University Heights, New York 53, N. Y.

G. W. Bills	Portland, Oreg.
C. R. Cahn	Syracuse, N. Y.
V. M. Cook	New York, N. Y.
E. D. Early	Birmingham, Ala.
R. N. Fitch	New York, N. Y.
R. G. Hooke	Newark, N. J.
L. K. Kirchmayer	Schenectady, N. Y.
W. J. Lyman	Pittsburgh, Pa.
C. W. Minard	Omaha, Nebr.
Bela Mohr	Oklahoma City, Okla.
H. B. Smith	Buffalo, N. Y.
H. T. Strandrud	Portland, Oreg.
V. A. Thiemann	New York, N. Y.
C. W. Watchorn	Baltimore, Md.

Joint AIEE-NEMA Brush Test Code Committee

F. R. Terrant, *Chairman;* The Reliance Electric & Engineering Company, 1068 Ivanhoe Road, Cleveland 10, Ohio

W. H. Austry	St. Marys, Pa.
R. J. Blais	New York, N. Y.
Hayes Crapo	Lima, Ohio
E. P. Eaton	Boonton, N. J.
W. R. Goss	Fort Wayne, Ind.
E. F. Hansen	West Lynn, Mass.
C. B. Hathaway	Buffalo, N. Y.
L. A. Heath	Long Island City, N. Y.
B. C. Henry	Ironton, Ohio
V. P. Hessler	Urbana, Ill.
H. T. Hulbert	St. Marys, Pa.
I. M. Levy	Dayton, Ohio
L. Lugosch	Johnsville, Pa.
I. H. Manfredo	New York, N. Y.
M. S. May	St. Marys, Pa.
H. F. Mitchel	Saginaw, Mich.
Dimiter Ramadanoff	Cleveland, Ohio
O. C. Rutledge	Schenectady, N. Y.
S. D. Summers	Washington, D. C.
H. R. Tragesser	Cleveland, Ohio
A. L. Van Emden	Washington, D. C.
W. W. Walker	Yonkers, N. Y.

Joint AIEE-IRE Subcommittee on High Frequency Measurements

R. V. Lowman, *Chairman;* Airborne Instruments Laboratory, Inc., 160 Old Country Road, Mineola, N. Y.

AIEE Members	
Ferdinand Hamburger, Jr., *Chairman*	Baltimore, Md.
R. G. Fellers	Washington, D. C.
R. K. Hellmann	Little Neck, N. Y.
J. W. Kearney	Mineola, N. Y.
D. D. King	Baltimore, Md.
Harold Lyons	Washington, D. C.
H. R. Meahl	Schenectady, N. Y.
D. C. Ports	Washington, D. C.
Ernst Weber	Brooklyn, N. Y.
A. H. Wing, Jr.	Evanston, Ill.
IRE Members	
R. V. Lowman, *Chairman*	Mineola, N. Y.
R. A. Braden	Princeton, N. J.
I. G. Easton	Cambridge, Mass.
F. J. Gaffney	Wyandanch, N. Y.
G. B. Hoadley	Raleigh, N. C.
E. W. Houghton	Murray Hill, N. J.
David Keim	Great Neck, N. Y.
B. M. Oliver	Palo Alto, Calif.
B. Parzen	Long Island City, N. Y.

Joint Subcommittee on Semiconductor Devices (Joint with IRE)

J. P. Jordan, *Chairman;* General Electric Company, Electronics Division, Electronics Park, Syracuse, N. Y.

C. A. Clarke	Nutley, N. J.
R. L. Crosby	St. Paul, Minn.
F. M. Dukat	Newton, Mass.
R. S. Fallows	Boston, Mass.
H. Goldberg	Washington, D. C.
H. F. Heath	Poughkeepsie, N. Y.
J. R. Hyneman	New York, N. Y.
H. Q. North	Culver City, Calif.
A. D. Rittmann	Philadelphia, Pa.
J. R. Roeder	Pittsburgh, Pa.
C. L. Roualt	Syracuse, N. Y.

AIEE-ASME Joint Committee on Recommended Specifications for the Speed Governing Prime Movers

W. C. Astley, *Chairman;* Philadelphia Electric Co., 900 Sansom Street, Philadelphia 4, Pa.

(*Personnel to be selected*)

AIEE Representatives

APPOINTED BY THE BOARD OF DIRECTORS

Alfred Noble Prize Committee, ASCE

E. W. Boehne	Cambridge, Mass.

American Association for the Advancement of Science, Council

J. W. Barker	New York, N. Y.
I. Melville Stein	Philadelphia, Pa.

American Standards Association, Standards Council

Charles Rufus Harte	New Haven, Conn.
J. R. North	Jackson, Mich.
A. C. Muir	Philadelphia, Pa.
Alternates	
R. C. Bergvall	Pittsburgh, Pa.
H. R. Huntley	New York, N. Y.
E. B. Paxton	Schenectady, N. Y.

AEC Advisory Committee on Industrial Information

Everett S. Lee	Schenectady, N. Y.

Conference of Representatives From Engineering Societies of Western Europe and USA

A. C. Monteith	Pittsburgh, Pa.
N. S. Hibshman	New York, N. Y.

Construction Industry Advisory Council

R. W. Wilbraham	Philadelphia, Pa.

Engineering Foundation Board

J. W. Barker	New York, N. Y.
E. I. Green	Murray Hill, N. J.

Engineering Societies Monographs Committee

W. F. Davidson	New York, N. Y.
R. W. Sorensen	Pasadena, Calif.

Engineers' Council for Professional Development

R. H. Barclay	New York, N. Y.
D. D. Ewing	Lafayette, Ind.
M. D. Hooven	Newark, N. J.

Engineers Joint Council

Walter J. Barrett	Newark, N. J.
N. S. Hibshman	New York, N. Y.
M. D. Hooven	Newark, N. J.
T. M. Linville	Schenectady, N. Y.
C. S. Purnell	New York, N. Y.
Alternates	
F. R. Benedict	Boston, Mass.
L. F. Hickernell	Hastings-on-Hudson, N. Y.
W. Scott Hill	Schenectady, N. Y.
Walter B. Morton	Allentown, Pa.
A. C. Muir	Philadelphia, Pa.

General Electric Educational Fund Fellowship Committee

Victor Siegfried	Worcester, Mass.

Hertz Award Committee

M. S. Coover	Ames, Iowa

Hoover Medal Board of Award

D. D. Ewing	Lafayette, Ind.
T. G. LeClair	Chicago, Ill.
D. C. Prince	Schenectady, N. Y.

John Fritz Medal Board of Award

T. G. LeClair	Chicago, Ill.
F. O. McMillan	Corvallis, Oreg.
D. A. Quarles	Washington, D. C.
Elgin B. Robertson	Dallas, Texas

Library Board, United Engineering Trustees, Inc.

N. S. Hibshman	New York, N. Y.
W. G. Vieth	New York, N. Y.

Marston Medal Board of Award

Harry B. Gear	Chicago, Ill.

National Association of Corrosion Engineers, Inter-Society Committee on Corrosion

Ray M. Wainwright, *Senior Delegate*	Urbana, Ill.
Hugo W. Wahlquist	New York, N. Y.

National Bureau of Engineering Registration, Advisory Board

R. G. Warner	New Haven, Conn.

National Electronics Conference, Board of Directors

J. D. Ryder	Urbana. Ill.

National Engineering Advisory Committee

A. H. Kehoe	New York, N. Y.

National Fire Waste Council

C. E. Ganther	Cleveland, Ohio
H. B. Whitaker	Chicago, Ill.

National Research Council, Division of Engineering and Industrial Research

J. A. Hutcheson	East Pittsburgh, Pa.

Quarterly of Applied Mathematics

M. G. Malti	Ithaca, N. Y.

United Engineering Trustees, Inc.

W. J. Barrett	Newark, N. J.
James F. Fairman	New York, N. Y.
A. G. Oehler	New York, N. Y.

U. S. National Committee of the International Commission on Illumination

R. L. Oetting	Cleveland, Ohio
R. C. Putnam	Cleveland, Ohio
E. H. Salter	New York, N. Y.

Washington Award Commission

J. F. Calvert	Pittsburgh, Pa.
D. D. Ewing	Lafayette, Ind.

World Power Conference, United States National Committee

T. G. LeClair	Chicago, Ill.
L. F. Hickernell, *Alternate*	Hastings-on-Hudson, N. Y.

Geographical District Executive Committees

	District	Chairman (Vice-President, AIEE)	Secretary (District Secretary)	Chairman, District Committees on Student Activities
1	North Eastern	G. J. Crowdes, Simplex Wire & Cable Co., 66 Sidney St., Cambridge, Mass.	D. E. Garr, General Electric Co., Schenectady, N. Y.	M. G. Malti, Dept. of Elec. Engg., Cornell University, Ithaca, N. Y.
2	Middle Eastern	W. B. Morton, Pennsylvania Power & Light Co., Ninth & Hamilton Sts., Allentown, Pa.	L. L. Nonemaker, Pennsylvania Power & Light Co., 901 Hamilton St., Allentown, Pa.	E. C. Dubbe, Dept. of Elec. Engg., West Virginia University, Morgantown, W. Va.
3	New York City	J. P. Neubauer, Consolidated Edison Co. of N. Y., Inc., 4 Irving Place, New York 3, N. Y.	L. F. Stone, General Electric Co., 744 Broad St., Newark 2, N. J.	R. E. Anderson, Dept. of Elec. Engg., Newark College of Engg., 367 High St., Newark 2, N. J.
4	Southern	C. P. Almon, Jr., Tennessee Valley Authority, 707 Power Bldg., Chattanooga, Tenn.	T. H. Mawson, Box 2641, Birmingham 2, Ala.	P. H. Nelson, Dept. of Elec. Engg., University of Florida, Gainesville, Fla.
5	Great Lakes	C. M. Summers, General Electric Co., Fort Wayne, Ind.	C. R. Schultz, Sangamo Elec. Co., Springfield, Ill.	E. L. Fairchild, Dept. of Elec. Engg., Wayne University, Detroit, Mich.
6	North Central	A. S. Anderson, General Electric Co., Apparatus Sales Division, Rocky Mountain District, Denver, Colo.	J. E. Martin, Public Service Co. of Colo., Dept. of Elec. Engg., Denver, Colo.	W. A. Hixson, Dept. of Elec. Engg., South Dakota School of M & T, Rapid City, S. Dak.
7	South West	S. M. Sharp, Southwestern Gas & Electric Co., P. O. Box 1106, Shreveport, La.	W. C. Morris, Jr., Southwestern Gas & Electric Co., Shreveport, La.	E. L. Sitz, Dept. of Elec. Engg., Kansas State College, Manhattan, Kansas
8	Pacific	G. C. Tenney, Editor, Electrical West, 68 Post St., San Francisco 4, Calif.	W. L. Carter, Pacific Tel. & Tel. Co., 140 New Montgomery St., San Francisco, Calif.	R. C. Lewis, Dept. of Elec. Engg., University of Southern Calif., Los Angeles, Calif.
9	North West	J. R. Walker, U. S. Bureau of Reclamation, Billings, Mont.	C. B. Brown, U. S. Bureau of Reclamation, Billings, Mont.	L. R. Kersey, Dept. of Elec. Engg., Univ. of British Columbia, Vancouver, B. C., Canada
10	Canada	G. D. Floyd, Hydro-Electric Power Comm. of Ont., 620 University Ave., Toronto, Ont., Canada	W. H. Prevey, Canadian General Electric Co. Ltd., 212 King St. West, Toronto 1, Ont., Canada	R. E. Phillips, Dept. of Elec. Engg., University of Alberta, Edmonton, Alta., Canada

NOTE: Each District executive committee includes also the chairmen and secretaries of all Sections within the Districts, the District vice-chairman of the AIEE Membership Committee, and a member of the Sections Committee who is a resident in the District.

Sections

Name	District	When Organized	Chairman	Secretary	Secretary's Address
Akron	2	Aug. 12, '20	Paul Berthold	J. E. Rose	General Electric Co., 335 South Main St., Akron, Ohio
Alabama	4	May 22, '29	D. D. Wendel	J. D. Sharp, Jr.	George M. Meriwether, 1712 7th Ave., No. Birmingham, Ala.
Arizona	8	Mar. 22, '41	E. A. Lodge	T. A. Phillips	1317 East Granada, Phoenix, Ariz.
Arkansas	7	Apr. 23, '47	D. A. Schmand	R. H. Boyd	Southwestern Bell Tel. Co., 900 W. Capital, Little Rock, Ark.
Arrowhead	5	Apr. 23, '47	H. A. Ruth	L. N. Day	General Electric Co., 14 West Superior St., Duluth 2, Minn.
Beaumont	7	June 27, '45	A. F. Briggs	Ray Welborn, Jr.	J. & J. Armature Works, 1136 Neches St., Beaumont, Texas
Boston	1	Feb. 13, '03	L. J. Weed	L. T. Jester, Jr.	General Electric Co., 140 Federal St., Boston 1, Mass.
Canton	2	Nov. 5, '47	D. Kalish	R. G. Fisher	Westinghouse Electric Corp., First Nat'l. Bank Bldg., Canton, Ohio
Central Illinois	5	June 28, '51	C. L. Eletson	W. J. Kelley	Illinois Power Co., 134 East Main St., Decatur, Illinois
Central Indiana	5	Jan. 12, '12	L. H. Wollenweber	E. E. Sterner	Western Electric Co., Inc., 2525 Shadeland, Indianapolis, Ind.
Chicago	5	1893	H. R. Heckendorn	R. B. Gear	Commonwealth Edison Co., 72 West Adams St., Chicago 90, Ill.
Cincinnati	2	June 30, '20	L. H. MacLaughlin	G. J. Brunner	Cincinnati Gas & Electric Co., 4th & Plum Sts., Cincinnati, Ohio
Cleveland	2	Sept. 27, '07	J. L. Fuller	E. M. Kooker	General Electric Co., Nela Park, Cleveland 12, Ohio
Columbus	2	Mar. 17, '22	Ben Harbage	W. E. Best	301 Loveman Ave., Worthington, Ohio
Connecticut	1	Apr. 16, '21	M. E. C. Devine	F. W. Engster	General Electric Co., 129 Church St., New Haven 10, Conn.
Corpus Christi	7	Oct. 25, '51	R. M. Eichner	M. H. Lovelady	Central Power & Light Co., 120 North Chaparral, Corpus Christi, Texas
Dayton	2	June 9, '43	Samuel Noodleman	Donald Warren	3105 Glen Rock Road, Dayton 10, Ohio
Delaware Bay	2	June 1, '52	O. L. Shorter	F. A. Anderson	E. I. DuPont De Nemours & Co., Wilmington 98, Del.
Denver	6	May 18, '15	H. A. Morgan	M. H. Kight	U. S. Bureau of Reclamation, Denver Federal Center, Denver, Colo.
East Tennessee	4	Sept. 2, '36	Frank Cross	T. A. Pearson	Knoxville Utilities Board, Electrical Engg. Dept., Knoxville, Tenn.
El Paso	7	Mar. 7, '40	F. L. Gutsch	F. E. Gray	Allis-Chalmers Mfg. Co., 608 Mills Bldg., El Paso, Texas
Erie	2	Jan. 11, '18	G. H. Ramandanes	T. J. Warrick	General Electric Co., Erie, Pa.
Fort Wayne	5	Aug. 14, '08	R. K. Drake	C. W. Brown	General Electric Co., 1635 Broadway, Fort Wayne Ind.
Georgia	4	Jan. 14, '04	E. V. McMahon	T. J. Allen	Georgia Power Co., P. O. Box 1719, Atlanta, Georgia
Hamilton	10	May 1, '53	W. J. Jackson	H. W. Blackett	Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada
Hawaii	8	June 24, '54	C. H. Williams	J. A. Rolfing, Jr.	Hawaiian Electric Co., Ltd., P. O. Box 2750, Honolulu, Hawaii
Houston	7	Aug. 7, '28	J. E. Fontaine	C. S. Williams, Jr.	Texas Pipe Line Co., Houston, Texas
Illinois Valley	5	June 30, '45	C. L. Teach	J. P. Hart	Central Illinois Light Co., 316 S. Jefferson, Peoria, Ill.
Iowa	5	June 29, '29	G. A. Richardson	R. F. Schlenker	Iowa Power & Light Co., 508—10th St., Des Moines, Iowa
Iowa-Illinois	5	June 24, '54	C. B. Stoughton	F. D. Newberry	Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa
Ithaca	1	Oct. 15, '02	J. R. Stover	J. L. Rosson	School of Elec. Engg., Cornell University, Ithaca, N. Y.
Jacksonville	4	Jan. 28, '31	W. L. Garlington	J. T. Graham	Allis-Chalmers Mfg. Co., 2031 Hendricks Ave., Jacksonville, Fla.
Kansas City	7	Apr. 14, '16	A. A. Dahms	L. M. Schindel	American Tel. & Tel. Co., 324 East 11th St., Kansas City 6, Mo.
Lehigh Valley	2	Apr. 16, '21	D. L. Greene	F. S. Fehr	Metropolitan Edison Co., P. O. Box 542, Reading, Pa.
Lima	2	June 24, '54	N. F. Schuh, Jr.	T. F. Hardman	Westinghouse Electric Corp., Lima, Ohio
Los Angeles	8	May 19, '08	G. T. Harness	P. L. Savage	General Electric Co., 212 N. Vignes St., Los Angeles 12, Calif.
Louisville	4	Oct. 15, '26	T. W. Talcott	J. F. Gregory	General Electric Co., Appliance Park, Louisville 1, Ky.
Lynn	1	Aug. 22, '11	J. R. Macintyre	F. O. MacFee, Jr.	General Electric Co., Bldg. 3-77, 920 Western Ave., Lynn, Mass.
Madison	5	Jan. 8, '09	F. B. Morgan	M. I. Smith	Wisconsin Power & Light Co., Madison, Wis.
Mansfield	2	Mar. 6, '39	R. L. Harrison	B. F. Parr	Westinghouse Electric Corp., 246 E. 4th St., Mansfield, Mass.
Maryland	2	Dec. 16, '04	P. L. Betz	H. A. Cramer, Jr.	Glenn L. Martin Co., Baltimore 2, Md.
Memphis	4	May 22, '30	John Thrithart	Claude Young	Westinghouse Electric Corp., 825 Exchange Bldg., Memphis 3, Tenn.
Mexico	7	June 29, '22	I. de Allende Pinuela	S. Ordonez Lezama	Plan de Ayala 34-1, Mexico 17, D. F. Mexico
Miami	4	Feb. 3, '49	C. W. Cogburn	F. B. Lucas	University of Miami, Coral Gables, Fla.
Michigan	5	Jan. 13, '11	J. J. Carey	H. R. Armstrong	Detroit Edison Co., 2000—2nd Ave., Detroit 26, Mich.
Milwaukee	5	Feb. 11, '10	R. C. Ball	R. H. Garrott	Dynamatic Corp., Kenosha, Wis.
Minnesota	5	Apr. 7, '02	P. A. Cartwright	R. G. Lynn	American Hoist & Derrick Co., 61 South Robert, St. Paul 1, Minn.
Mississippi	4	June 28, '51	R. D. Yarbrough	T. M. Salisbury	Gregory-Salisbury & Co., Jackson, Miss.
Mobile-Pensacola	4	Jan. 22, '53	John J. Petruska	L. A. McGraw	General Electric Co., Mobile, Ala.
Montana	9	June 24, '31	L. R. Schumacher	R. L. Barta	U. S. Bureau of Reclamation, Billings, Montana
Montreal	10	Apr. 16, '43	C. A. Wright	A. C. Abbott	The Shawinigan Water & Power Co., P. O. Box 6072, Montreal, P. Q., Canada
Nashville	4	June 28, '51	R. B. Sanderford	W. C. Raiford	U. S. Corps of Engineers, Engineering Divn., Nashville, Tenn.
Nebraska	6	Jan. 21, '25	H. L. Meyer	E. J. Ballard, Jr.	University of Nebraska, Lincoln 8, Nebraska
New Hampshire	1	Sept. 3, '53	R. W. Hunt	R. A. Nichols	Public Service Co. of N. H., 1087 Elm St., Manchester, N. H.
New Orleans	4	Dec. 8, '33	H. C. Swan	D. H. Vliet	Tulane University, New Orleans, La.
New York	3	Dec. 10, '19	J. R. Kerner	W. A. Clark	American Telephone and Telegraph, 195 Broadway, New York, N. Y.
Niagara Frontier	1	Feb. 10, '25	L. J. Murphy	D. J. Munhall	Munhall Company, 170 Franklin St., Buffalo 2, N. Y.
Niagara International	10	Aug. 5, '48	A. W. Walmsley	A. H. Redfern	Union Carbide & Carbon Corp., Electro Metallurgical Div., Niagara Falls, N. Y.
North Carolina	4	Mar. 21, '29	H. W. Oetinger	G. L. Peeler	Southern Bell Tel. & Tel. Co., P. O. Box 240, Charlotte, N. C.
Northeastern Michigan	5	Feb. 2, '50	W. F. Schultz	R. L. Hibbard	Cutler-Hammer, Inc., 107 N. Franklin St., Saginaw, Michigan
Northern New Mexico	7	Jan. 25, '51	R. A. Tynes	L. M. Swenson	104 El Cortez Bldg., Albuquerque, N. Mexico
North Texas	7	May 18, '28	P. S. Neblett	C. A. Maas	General Electric Co., 1801 North Lamar St., Dallas, Texas
Oak Ridge	4	Feb. 1950	W. H. Lee	D. B. Janney	104 Delmar Circle, Oak Ridge, Tenn.
Ohio Valley	2	June 28, '51	H. P. Hageman	J. C. Wall	Enslow Machinery Co., 1401—8th Ave., Huntington, West Virginia
Oklahoma City	7	Feb. 16, '22	R. E. Thornton	E. L. Hassler	Southwestern Bell Tel. Co., 210 Northwest 6th St., Oklahoma City 2, Okla.
Ottawa	10	June 23, '49	W. J. Purvis	G. Y. Slader	Gatineau Power Co., 140 Wellington St., Ottawa, Ont., Canada
Panhandle Plains	7	June 12, '47	C. R. Garst	R. K. Owen	Southwestern Public Service Co., P. O. Box 631, Borger, Texas
Philadelphia	2	Feb. 18, '03	A. E. Pringle, II	M. J. A. Dugan	General Cable Company, 123 So. Broad St., Philadelphia 9, Pa.
Pittsburgh	2	Oct. 3, '02	E. S. Reeser	W. H. Osterle	West Penn Power Co., 14 Wood St., Pittsburgh 22, Pa.
Pittsfield	1	Mar. 25, '04	J. C. Russ	J. O. Sweeny	General Electric Co., 100 Woodlawn Ave., Pittsfield, Mass.
Portland	9	May 18, '09	F. J. Maas	A. E. Opdenweyer	Portland General Electric Co., 1510 SE Water Ave., Portland 14, Oreg.
Providence	1	Mar. 12, '20	J. R. Toomey	Virginia M. Berndt	Blackstone Valley Gas & Electric Co., 55 High St., Pawtucket, R. I.
Richland	9	Apr. 23, '48	E. H. Olsen	C. B. Wagner	Hanford Works, General Electric Co., Richland, Wash.
Ridgway	2	June 26, '52	L. F. Simbeck	W. E. Yohe	Stackpole Carbon Co., St. Marys, Pa.
Rochester	1	Oct. 9, '14	A. V. Dasburg	H. A. Brown	Rochester Gas & Electric Corp., 89 East Ave., Rochester 4, N. Y.
Rock River Valley	5	Apr. 23, '47	B. T. Anderson	O. L. Welker	2928 Lawndale Ave., Rockford, Ill.
Sacramento	8	June 15, '50	C. R. Koch	M. N. Davis	Sacramento Utility District, 2101 K St., Sacramento, Calif.
St. Louis	7	Jan. 14, '03	A. E. Marshall	R. J. W. Koopman	Washington University, St. Louis 5, Mo.
St. Maurice Valley	10	June 24, '54	A. E. Curtis	E. A. Gareau	Shawinigan Water & Power Co., Rapide Blanc, Que., Canada
San Diego	8	Jan. 18, '39	E. F. Kotnik	C. R. Lufkin	General Electric Co., 1240 Seventh Ave., San Diego 1, Calif.
San Francisco	8	Dec. 23, '04	W. A. Howe	W. G. Collins	Pacific Tel. & Tel. Co., 149 New Montgomery St., San Francisco, Calif.
Schenectady	1	Jan. 26, '03	L. F. Lewis	D. H. Ware	General Electric Co., Schenectady 5, N. Y.
Seattle	9	Jan. 19, '04	J. V. Lamson	A. W. Kessler	Westinghouse Electric Corp., 3451 E. Marginal Way, Seattle, Wash.
Sharon	2	Dec. 11, '25	L. J. Besch	H. L. Prescott	Westinghouse Electric Corp., Sharon, Pa.
Shreveport	7	June 12, '47	E. C. Riall, Jr.	L. C. Barry	Southwestern Gas & Electric Co., 428 Travis St., Shreveport, La.
South Bend	5	Feb. 26, '41	H. B. Kumm	J. W. Stuart	Westinghouse Electric Corp., 216 E. Wayne St., South Bend, Indiana
South Carolina	4	Mar. 2, '40	G. A. Black	F. T. Tingley	Clemson A & M College, Clemson, S. C.
South Texas	7	May 23, '30	A. A. Mollenhauer	R. M. Jolly	San Antonio City Public Service Board, Transmission & Distribution Div., San Antonio, Texas
Spokane	9	Feb. 14, '13	H. C. Martindale	J. R. Angell	911 N. Locust Lane, Route 3, Opportunity, Wash.
Springfield	1	June 29, '22	R. E. Begley	M. G. Moses	Western Massachusetts Electric Co., 73 State St., Springfield, Mass.
Susquehanna	2	June 18, '53	K. J. Granbois	W. A. Lentz	Metropolitan Edison Co., 27 W. Market St., York, Pa.
Syracuse	1	Aug. 12, '20	T. DeVore	J. W. Becker	Allis-Chalmers Mfg. Co., 472 South Salina St., Syracuse 2, N. Y.
Tampa	4	Feb. 1, '52	I. L. Garcia	N. J. Patterson	3902 McKay Avenue, Tampa, Fla.
Toledo	2	June 3, '07	J. W. Cofer	J. F. Craig	Westinghouse Electric Corp., 1308 Toledo Trust Bldg., Toledo 4, Ohio
Toronto	10	Sept. 30, '03	P. J. Croft	R. J. Brown	Moloney Electric Co., 213 Sterling Road, Toronto 3, Ont., Canada

Sections (cont.)

Name	District	When Organized	Chairman	Secretary	Secretary's Address
Tulsa	7	Oct. 1, '37	R. D. Bennett	R. S. Terhune	Nelson Electric Mfg. Co., 217 N. Detroit, Tulsa, Oklahoma
Utah	9	Mar. 9, '17	D. R. Allsop	J. A. Davis	General Electric Co., 200 S. Main St., Salt Lake City, Utah
Vancouver	9	Aug. 22, '11	H. O. Bulmer	R. B. Carter	Canadian Westinghouse Co., Ltd., 1418 Marine Blvd., Vancouver, B. C., Canada
Virginia	4	May 19, '22	D. N. Rice	W. P. Molette	General Electric Co., 700 East Franklin St., Richmond 17, Va.
Virginia Mountain	4	June 23, '49	H. A. Clarke	J. O. Bewley, Jr.	General Electric Co., Roanoke, Va.
Washington	2	Apr. 9, '03	W. J. Ellenberger	C. E. Bennett	Federal Power Commission, Bureau of Power, Hurley-Wright Bldg., Washington, D. C.
West Michigan	5	June 24, '54	L. W. Zahorsky	M. C. Hoover	Electric Sorting Machine Co., 410—44th St., S. W., Grand Rapids, Mich.
West Virginia	2	Apr. 9, '40	G. W. Unangst	R. H. Greame	P. O. Box 911, Charleston, W. Va.
Wichita	7	Sept. 16, '37	R. E. Phillip	Ralph Longstaff	Kansas Gas & Electric Co., Wichita 1, Kansas
Worcester	1	Feb. 18, '20	W. H. Howard	D. J. Allia	New England Power Service Co., 939 Southbridge St., Worcester 10, Mass.
Total Sections	105				

Subsections

Name	Chairman	Secretary	Secretary's Address
Adirondack (Schenectady Section)	M. E. Noon	R. A. Ruscetta	Capacitor Dept., General Electric Co., Hudson Falls, N. Y.
Atlantic City Division (Philadelphia Section)	C. W. Behler	J. S. Braddock	Atlantic City Electric Co., 1600 Pacific Ave., Atlantic City, N. J.
Baton Rouge (New Orleans Section)	E. H. Coxe	J. W. Elder	3177 Eugene St., Baton Rouge 6, Louisiana
Billings (Montana Section)	R. H. Osborne	F. W. Lachicotte, Jr.	226 Avenue D, Billings, Montana
Binghamton Area (Ithaca Section)	L. J. Sitterlee	L. N. Vacca	International Business Machines Corp., Vestal Laboratory, Vestal, New York
Black Hills (Denver Section)	Rex Tario	E. R. Shields	405½ Spark Street, Lead, S. D.
Boise (Utah Section)	R. E. Alworth	D. L. Andrews	2520 Jefferson St., Boise, Idaho
Boulder City (Los Angeles Section)	C. F. Neumann	D. D. Dutter	Hoover Hydro Div., Southern Calif. Edison Co., 5th & Grand, Los Angeles, Calif.
Casper Wyo. (Denver Section)			
Central Texas (North Texas Section)	R. J. Sayger	M. R. Espin	J. H. Flood Electrical Repair Shop, Blackland Airport Warehouse, Waco, Texas
Centre County (Pittsburgh Section)	P. E. Shields	A. H. Forbes	Pennsylvania State University, State College, Pa.
Charleston (South Carolina Section)	F. J. Fishbourne	H. N. Cyrus	South Carolina Public Service Authority, Moncks Corner, S. C.
Charlotte (North Carolina Section)	W. J. Wortman	J. G. Alexander	Southern Bell Tel. & Tel. Co., 1701 Johnston Bldg., Charlotte, N. C.
Chillicothe (Columbus Section)	R. J. Huntemer	M. H. Borland	Mead Corp., Chillicothe, Ohio
Columbia (South Carolina Section)	J. H. Noland	L. P. Thompson, Jr.	Southern Bell Tel & Tel. Co., 408 Owen Bldg., Columbia 1, S. C.
East St. Louis (St. Louis Section)	W. P. Ernsberger	Jack Lawrence	136 W. Halley Drive, East Alton, Ill.
Eastern North Carolina (North Carolina Section)	A. J. Hill	W. R. Hanchey	P. O. Box 575, Raleigh, N. C.
Eastern Shore (Maryland Section)	W. R. Logan	R. P. Graham	Eastern Shore Public Service Co., 114 N. Division St., Salisbury, Md.
Fort Worth (North Texas Section)	B. M. Gallaher	J. C. Bibbs	Westinghouse Electric Co., 1310 Electric Bldg., Fort Worth, Texas
Fox River Valley (Milwaukee Section)	G. S. Johnson	R. R. Schmitz	222 Gillett St., Fond Du Lac, Wis.
Freeport (Houston Section)	J. J. Jacquin	N. A. Kurio	431 Center Way, Lake Jackson, Texas
Fresno Division (San Francisco Section)	J. W. Graham	E. R. Tomblin	General Electric Co., 407 Patterson Bldg., Fresno, Calif.
Great Falls (Montana Section)			
Hampton Roads (Virginia Section)	W. T. Stone	D. J. Ball	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.
Hudson Valley Division (New York Section)	W. R. Peters		
Huntsville (East Tennessee Section)	J. H. Kastanakis	R. W. Milner, Jr.	Redstone Arsenal, Huntsville, Alabama
Idaho Falls (Utah Section)			
Johnstown (Pittsburgh Section)	R. H. Barnes	J. C. Maleck	General Electric Co., 841 Oak St., Johnstown, Pa.
Lake Charles (Beaumont Section)	J. P. Hynds	J. R. Boozer	Service Dept., Southern Alkali Corp., Lake Charles, La.
Lexington (Louisville Section)	S. J. Burdette	Vaughn Drake	General Telephone Co., Lexington, Ky.
London (Hamilton Section)	D. N. Culver	L. P. Atkins	340 Weilington St., London, Ont., Canada
Maine (Lynn Section)	Basil Payne	S. A. Hutchinson	42 Parsons Road, Portland, Maine
Marion (Fort Wayne Section)			
Mid-State (North Carolina Section)	J. C. Bregar	D. H. Mitchell	808 Melrose St., Winston-Salem, N. C.
Monroe (Shreveport Section)	D. E. Bivins	T. A. Pitt	P. O. Drawer 1572, Monroe, La.
Montgomery (Alabama Section)			
Muscle Shoals (East Tennessee Section)	E. B. Foster	Richard Darcy	3301—19th Ave., Sheffield, Ala.
New Jersey Division (New York Section)	B. B. Jordan		
Northwest Arkansas (Arkansas Section)	Frank Hinkle	J. R. McConnell	Southwestern Bell Telephone Co., 101 N. 13th St., Fort Smith, Ark.
Paducah (Louisville Section)	R. J. Thomas	R. J. Wershing	Carbide & Carbon Chemical Co., Paducah, Ky.
Piedmont (South Carolina Section)	H. F. Pitts	W. F. Rochester	Route 2, Taylors, S. C.
Racine-Kenosha (Milwaukee Section)	R. R. Dirksen	R. Rowell	4933 Charles St., Racine, Wis.
Red River Valley Division (Minnesota Section)	J. S. Love	E. M. Anderson	North Dakota State College, Fargo, N. Dak.
Reno (San Francisco Section)	F. G. Wells	M. S. Murphy	Bell Telephone Co. of Nevada, 100 No. Center St., Reno, Nev.
Richmond (Virginia Section)	W. T. Stone	C. M. Stallings	Virginia Electric & Power Co., Richmond, Va.
St. Lawrence International (Syracuse Section)	Joel Tompkins	Peter Nevaldine	Industrial Dept., New York State Agricultural & Technical Institute, Canton, N. Y.
San Jose (San Francisco Section)	E. C. Glover	E. L. Kostainsek	General Electric Co., Bank of America Bldg., San Jose, Calif.
Savannah (Georgia Section)	P. E. Seawright	J. E. Odom	Union Bag & Paper Corp., Savannah, Georgia
Scioto Valley (Ohio Valley Section)	W. M. Lewis, Jr.	C. H. McCann, Jr.	4144 Gallia St., New Boston, Ohio
Shasta Division (San Francisco Section)	G. D. Atkinson, Jr.	T. D. Martin	Pacific Gas & Electric Co., Orland, Calif.
Southern Colorado (Denver Section)	G. F. Wallis	G. D. Perry, Jr.	Southern Colorado Power Co., Pueblo, Colo.
Tacoma (Seattle Section)	R. J. Franzen	H. L. Fritz	The Tide Co., 1512 Center St., Tacoma, Wash.
Tullahoma (East Tennessee Section)	C. A. McGuiness	R. L. Simenson	General Delivery, Tullahoma, Tenn.
Vancouver Island (Vancouver Section)	T. E. Dickson	A. Roos	B. C. Power Commission, Victoria, B. C., Canada
Vermont (Pittsfield Section)			
Wenatchee (Spokane Section)	W. E. Mathews	E. C. Metcalf	926 Idaho St., Wenatchee, Wash.
West Central Texas Division (North Texas Section)	A. C. Mierow	J. K. Covington	266½ Cypress, Abilene, Texas
Western North Carolina (North Carolina Section)	Ray Foster		
Youngstown (Sharon Section)	E. A. Mort		
Zanesville (Columbus Section)	C. R. Acker	W. N. Bovenizer	Line Material Co., Zanesville, Ohio
Total Subsections 60			

Student Branches

Name and Location	District	Counselor (Member of Faculty)
*Akron, University of, Akron, Ohio	2	Kenneth F. Sibila
Alabama Polytechnic Institute, Auburn	4	Albert T. Sprague, Jr.
Alabama, University of, University	4	W. F. Gray
*Alberta, University of, Edmonton, Canada	10	R. E. Phillips
*Arizona, University of, Tucson	8	J. L. Knickerbocker
*Arkansas, University of, Fayetteville	7	D. D. Lingelbach
*British Columbia, University of, Vancouver, Canada	9	L. R. Kersey
*Brooklyn, Polytechnic Institute of, Brooklyn, N. Y., (Day)	3	F. A. Wahlers
Brooklyn, Polytechnic Institute of, Brooklyn, N. Y., (Evening)	3	F. G. Van Note
*Brown University, Providence, R. I.	1	F. N. Tompkins
*Bucknell University, Lewisburg, Pa.	2	G. A. Irland
*California Institute of Technology, Pasadena	8	G. D. McCann
*California, University of, Berkeley	8	C. F. Dalziel
*Carnegie Institute of Technology, Pittsburgh, Pa.	2	A. T. Murphy
Case Institute of Technology, Cleveland, Ohio	2	N. E. Prochaska
Catholic University of America, Washington, D. C.	2	J. C. Michalowicz
*Cincinnati, University of, Cincinnati, Ohio	2	C. F. Evert, Jr.
Clarkson College of Technology, Potsdam, N. Y.	1	Chester Russell
Clemson A & M College, Clemson, S. C.	4	F. T. Tingley
*Colorado A & M College, Fort Collins	6	J. E. Dean
*Colorado, University of, Boulder	6	S. I. Pearson
*Columbia University, New York, N. Y.	3	W. A. LaPierre
*Connecticut, University of, Storrs	1	G. W. Johnson
*Cooper Union, New York, N. Y.	3	E. W. Starr
*Cornell University, Ithaca, N. Y.	1	M. G. Malti
*Dayton, University of, Dayton, Ohio	2	L. H. Rose
*Delaware, University of, Newark, Del.	2	R. V. Canning
*Denver, University of, Denver, Colo.	6	A. E. Paige
*Detroit, University of, Detroit, Mich.	5	R. W. Ahlquist
*Drexel Institute of Technology, Philadelphia	2	F. C. Powell
Duke University, Durham, N. C.	4	C. R. Vail
Fenn College, Cleveland, Ohio	2	R. W. Schindler
*Florida, University of, Gainesville	4	P. H. Nelson
*George Washington University, Washington, D. C.	2	N. B. Ames
Georgia Institute of Technology, Atlanta	4	E. R. Weston
Howard University, Washington, D. C.	2	E. R. Welch
Idaho, University of, Moscow	9	W. R. Parish
Illinois Institute of Technology, Chicago	5	B. A. Fisher
*Illinois, University of, Urbana, and Chicago Division, Chicago	5	E. A. Reid
*Iowa State College, Ames	5	G. A. Richardson
Iowa, University of, Iowa City	5	E. B. Kurtz
*Johns Hopkins University, Baltimore, Md.	2	Thorstein Larsen
Kansas State College, Manhattan	7	E. L. Sitz
*Kansas, University of, Lawrence	7	E. L. Jordan
Kentucky, University of, Lexington	4	G. E. Smith
*Lafayette College, Easton, Pa.	2	F. W. Smith
Laval University, Quebec, Canada	10	
Lehigh University, Bethlehem, Pa.	2	Joseph Teno
Louisiana Polytechnic Institute, Ruston	7	M. R. Johnson
*Louisiana State University, Baton Rouge	4	A. K. Ramsey, Jr.
*Louisville, University of, Louisville, Ky.	4	M. G. Northrop
*Maine, University of, Orono	1	
*Manhattan College, New York, N. Y.	3	R. T. Weil, Jr.
*Marquette University, Milwaukee, Wis.	5	E. W. Kane
*Maryland, University of, College Park	2	L. J. Hodgins
*Massachusetts Institute of Technology, Cambridge	1	H. E. Edgerton
*Massachusetts, University of, Amherst	1	
*Michigan College of Mining and Technology, Houghton	5	G. W. Swenson
*Michigan State College, East Lansing	5	P. G. Gray
*Michigan, University of, Ann Arbor	5	William Kerr, Jr.
Milwaukee School of Engineering, Milwaukee, Wis.	5	R. J. Ungrodt
*Minnesota, University of, Minneapolis	5	P. A. Cartwright
Mississippi State College, State College	4	J. C. McKee, Jr.
*Missouri School of Mines and Metallurgy, Rolla	7	C. J. Grimm
*Missouri, University of, Columbia	7	J. R. Tudor
*Montana State College, Bozeman	9	G. D. Sheckels
*Nebraska, University of, Lincoln	6	A. R. Edison
Nevada, University of, Reno	8	W. L. Garrott
Newark College of Engineering, Newark, N. J.	3	R. E. Anderson
*New Hampshire, University of, Durham	1	
*New Mexico College of A & M Arts, State College	7	C. D. Crosno
*New Mexico, University of, Albuquerque	7	R. W. Tapy
*New York, College of the City of, New York	3	Harold Wolf
*New York University, New York, (Day)	3	S. S. L. Chang
*New York University, New York, (Evening)	3	G. Calabrese
*North Carolina State College, Raleigh	4	W. D. Stevenson, Jr.
*North Dakota State College, Fargo	5	R. N. Faiman
*North Dakota, University of, Grand Forks	5	J. D. Dixon
*Northeastern University, Boston, Mass.	1	
*Northwestern University, Evanston, Ill.	5	D. J. Ford
Norwich University, Northfield, Vt.	1	
*Notre Dame, University of, Notre Dame, Ind.	5	L. F. Stauder
Ohio Northern University, Ada, Ohio	2	D. W. Davis
*Ohio State University, Columbus	2	N. A. Smith
*Ohio University, Athens	2	D. B. Green
*Oklahoma A & M College, Stillwater	7	D. L. Johnson
Oklahoma, University of, Norman	7	W. B. Lewis
*Oregon State College, Corvallis	9	L. N. Stone
*Pennsylvania State College, State College	2	A. P. Powell
*Pennsylvania, University of, Philadelphia	2	E. I. Hawthorne
Pittsburgh, University of, Pittsburgh, Pa.	2	R. C. Gorham
*Pratt Institute, Brooklyn, N. Y.	3	Maurice Hashmall
*Princeton University, Princeton, N. J.	2	H. M. Chandler, Jr.
Puerto Rico, University of, Mayaguez	3	Miguel Wiewall
Purdue University, Lafayette, Ind.	5	Stephen Freeman, Jr.
*Rensselaer Polytechnic Institute, Troy, N. Y.	1	
*Rhode Island, University of, Kingston	1	
Rice Institute, Houston, Texas	7	P. E. Pfeiffer
Rose Polytechnic Institute, Terre Haute, Ind.	5	R. D. Strum
*Rutgers University, New Brunswick, N. J.	3	J. P. Newton
Saint Louis University, St. Louis, Mo.	7	W. M. McCabe
Santa Clara, University of, Santa Clara, Calif.	8	H. P. Nettesheim
*South Carolina, University of, Columbia	4	J. H. Noland, Jr.
*South Dakota School of Mines and Technology, Rapid City	6	W. A. Hixon
South Dakota State College, Brookings	5	J. N. Cheadle
*Southern California, University of, Los Angeles	8	R. C. Lewis
*Southern Methodist University, Dallas, Texas	7	W. W. Koepsel
*Stanford University, Stanford, Calif.	8	W. G. Hoover
*Stevens Institute of Technology, Hoboken, N. J.	3	L. E. Backer
Swarthmore College, Swarthmore, Pa.	2	Carl Barus
*Syracuse University, Syracuse, N. Y.	1	Edward Erdelyi
Tennessee, University of, Knoxville	4	L. W. Ricketts
*Texas, A & M College of, College Station	7	N. F. Rode
*Texas Technological College, Lubbock	7	W. A. Blackwell
*Texas, University of, Austin, and Texas Western College Sub-Branch, El Paso	7	R. R. Krezdorn
*Toledo, University of, Toledo, Ohio	2	H. O. Sautter
*Toronto, University of, Toronto, Ont., Canada	10	J. E. Reid
*Tufts College, Medford, Mass.	1	
*Tulane University, New Orleans, La.	4	J. A. Cronvich
Union College, Schenectady, N. Y.	1	
United States Naval Academy, Annapolis, Md.	2	W. K. Kay
*Utah, University of, Salt Lake City	9	R. E. Stephenson
Vanderbilt University, Nashville, Tenn.	4	Walter Criley
*Vermont, University of, Burlington	1	W. L. Steinmann
*Villanova College, Villanova, Pa.	2	J. B. Clothier, Jr.
Virginia Military Institute, Lexington	4	L. L. Nichols, Jr.
*Virginia Polytechnic Institute, Blacksburg	4	Claudius Lee
*Virginia, University of, Charlottesville, Va.	4	C. M. Siegel
Washington, State College of, Pullman	9	O. E. Osburn
*Washington, University of, Seattle	9	F. D. Robbins
*Washington University, St. Louis, Mo.	7	Pierre Honnell
*Wayne University, Detroit, Mich.	5	E. L. Fairchild
*West Virginia University, Morgantown	2	E. C. Dubbe
*Wisconsin, University of, Madison	5	H. A. Peterson
*Worcester Polytechnic Institute, Worcester, Mass.	1	
*Wyoming, University of, Laramie	6	R. K. Beach
*Yale University, New Haven, Conn.	1	

Total Branches......................135

*Joint AIEE-IRE Branches............ 95

1954-1955 AIEE General and District Meetings

1954 Middle Eastern District Meeting
October 5–7, Reading, Pa.
W. B. Morton, General Chairman

1954 Fall General Meeting
October 11–15, Chicago, Ill.
F. A. Cox, General Chairman

1955 Winter General Meeting
January 31–February 4, New York City
A. J. Cooper, General Chairman

1955 Southern District Meeting
April 13–15, St. Petersburg, Fla.
I. L. Garcia, General Chairman

1955 Middle Eastern District Meeting
May 4–6, Columbus, Ohio
G. M. L. Sommerman, General Chairman

1955 Summer General Meeting
June 27–July 1, Swampscott, Mass.
M. A. Princi, General Chairman

1955 Pacific General Meeting
August 15–19, Butte, Mont.
W. H. Mott, General Chairman

1955 Fall General Meeting
October 3–7, Chicago, Ill.

OF CURRENT INTEREST

Silencer Units for Ground Operations of Jets Added to Sound Abatement System

Three advanced silencer units for ground operations of the nation's newest and most powerful jet airplanes and engines have been added to North American Aviation's sound abatement system at the company's fighter assembly lines at Los Angeles (Calif.) International Airport.

The new facilities will be used in ground operations of the *F-100* Super Sabre, first production airplane capable of exceeding the speed of sound in normal, level flight, and for acceptance testing of its Pratt-Whitney *J-57* engines.

Eight other sound reduction units are in use by North American for ground operations of the *F-86* Sabre Jet series. The first of the silencers was placed in operation during 1948, and other improved units were added with advances in airplane designs and new developments in jet power.

Largest of the three new silencers is a $261,000 chamber for testing the *J-57* power plants. The jet engine develops 10,000 pounds of static thrust and is the nation's most powerful.

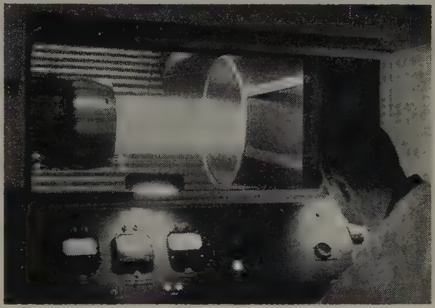
Engines operating at full power are barely audible 250 feet from the abatement unit.

Sound of the engine during runups is contained by the chamber's 3-foot-thick walls. Constructed of corrugated steel plates 1/8 inch thick and separated by tons of sand, the walls are slightly elastic and absorb the sound energy of the operations.

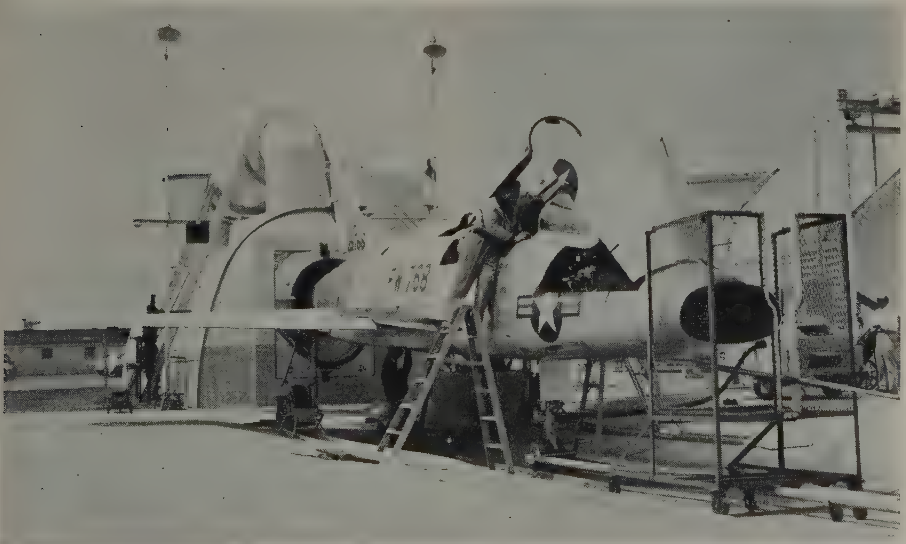
A 45-foot-long muffler, 6 feet in diameter, catches more of the sound and is water-cooled to absorb nearly all of the 3,500 degrees of heat produced by full-power operations. An automatic water ring sprays 480 gallons of water a minute into the muffler, where the heat so nearly evaporates the liquid that only a few wisps of steam are visible from the chamber's exhaust stack.

Air is sucked into the chamber and the mouth of the powerful jet engine through six inlet silencers on the roof of the test facility. The openings admit 100 pounds of air each second, enough to change the air in 50 homes every second.

During the acceptance testing, the engines are operated from two instrument panels in a control room outside one wall of the test chamber. Technicians watch the operations



A bright bar of flame cuts through the darkened chamber of North American Aviation's newest sound abatement facility during afterburner operations in acceptance tests of an F-100 Super Sabre's J-57 jet engine. Technicians operate and inspect the engines behind two observation windows constructed of four panels of bulletproof glass in a control room to the side of the abatement chamber



Sound abatement chamber on flight line reduces test sounds. Tailpipe of the fighters juts through opening in the silencer unit where it is fitted with a nearly soundproof asbestos collar

Future Meetings of Other Societies

American Institute of Chemical Engineers. National Meeting. September 12–16, 1954, Hotel Colorado, Glenwood Springs, Colo.

American Transit Association. Annual Meeting. September 27–30, 1954, Hotel William Penn, Pittsburgh, Pa.

Association of Iron and Steel Engineers. Annual Meeting. September 28–October 1, 1954. Cleveland Public Auditorium, Cleveland, Ohio.

Building Research Institute. Conference on Plastics in Building. October 27–28, 1954, National Academy of Sciences, Washington, D. C.

Canadian Electrical Manufacturers Association. 10th Annual Meeting. September 22–24, 1954, Sheraton-Brock Hotel, Niagara Falls, Ont., Canada

Conference on Cryogenic Engineering. September 8–10, 1954, Cryogenic Engineering Laboratory, Boulder, Colo.

Engineers' Council for Professional Development. 22d Annual Meeting. October 28–29, 1954, Hotel Alms, Cincinnati, Ohio

Illuminating Engineering Society. National Technical Conference. September 13–17, 1954, Chalfonte-Haddon Hall, Atlantic City, N. J.

Institute of Radio Engineers. Symposium on Industrial Electronics. September 29–30, 1954, Mellon Institute, Pittsburgh, Pa.

Institute of Radio Engineers—Professional Group on Nuclear Science. 1st National Annual Meeting. October 6–7, 1954, Hotel Sherman, Chicago,Ill.

Instrument Society of America. 1st International Instrument Congress and Exposition. September 15–21, 1954, Convention Hall, Philadelphia, Pa.

International Association of Electrical Leagues. September 29–October 2, 1954, Bellevue Stratford Hotel, Philadelphia, Pa.

International Electrotechnical Commission. Golden Jubilee Meeting. September 1–16, 1954, University of Pennsylvania, Philadelphia, Pa.

Joint Electron Tube Engineering Council. General Conference. September 16–18, 1954, Chalfonte-Haddon Hall, Atlantic City, N. J.

National Association of Corrosion Engineers. South Central Region Meeting October 14–15, 1954, Dallas, Tex.

National Bureau of Standards. Symposium on Propagation, Standards, and Problems of the Ionosphere. September 8–11, 1954, Boulder, Colo.

National Electronics Conference. 10th Annual Conference. October 4–6, 1954, Hotel Sherman, Chicago, Ill.

National Federation of the Radioelectric and Electronic Industries of France. 17th French Radio and Television Exhibition. October 2–12, 1954, Musee des Travaux Publics, Paris, France

National Safety Council. 42d National Safety Congress and Exposition. October 18–22, 1954, Chicago, Ill.

Radio Technical Commission for Aeronautics. Fall Assembly Meeting. September 30–October 1, 1954, Washington, D. C.

Society of Automotive Engineers. National Tractor Meeting and Production Forum. September 13–16, 1954, Hotel Schroeder, Milwaukee, Wis.

Standards Engineers Society. Annual Meeting. October 1–2, 1954, Haddon Hall, Atlantic City, N. J.

The American Society of Mechanical Engineers. Fall Meeting. September 8–10, 1954, Hotel Schroeder, Milwaukee, Wis.

through two large observation windows constructed of four panels of bulletproof glass.

Mirrors mounted on the internal walls of the chamber give the technicians a clear view of each external part of the engine.

The two other units for ground operations of the *F-100* Super Sabre utilize similar test chambers and silencer systems. The tail pipe of the Super Sabre is fitted into an opening in the unit and surrounded by a huge "washer" of asbestos cloth. The engine is operated from the cockpit of the supersonic fighter.

The use of corrugated steel plate and a sand filling for muffling the sound of operations reduces sound energy by the cushioning effect of the steel plate and sand.

The slight elasticity of the walls allows the sound energy to be transferred to the sand filling where the movement of each grain absorbs and dissipates the force.

The 810 tons of special-grade sand between the walls of the test chamber were carefully dried before they were poured in place. Dryness allows freer movement of the grains.

Safety features installed in the engine test unit include a device automatically to sample air in the chamber for critical mixtures of unburned fuel and oxygen, and an extensive system of water fog to combat fire.

Transformer Test Center and Sound Laboratory to be Built

A new multimillion-dollar sound laboratory and test center for transformers will be built at Westinghouse Electric Corporation's Transformer Division plant in Sharon, Pa., and it will be ready for operation by early next year.

To be erected in a 200-foot-long extension of four existing assembly aisles at the Sharon plant, the test center will offer something new in industrial operations. Every one of the power transformers that is manufactured will be carried by overhead crane into the test center and undergo a series of examinations and electrical tests before it is shipped to the customer.

At one point, the transformer can be bombarded by 5 million volts and 275 thousand amperes worth of man-made lightning. Only a few feet away from this thunderous noise will be one of the quietest spots in the world—a building erected inside the over-all test building and housing an ultramodern sound laboratory.

This sound laboratory will be 70 feet long, 56 feet wide, and 55 feet high. It will be constructed so that it will be virtually impossible for sound to enter or to leave the laboratory. The floor will be concrete, 3 feet thick. The 5-foot-thick walls will be made of concrete, several inches of air space, and Fiberglas. On the inside, the walls will be covered with Fiberglas wedges and wire mesh to prevent reflection of sound. Within the walls of the sound laboratory will be metallic shielding to prevent even radio waves from entering the laboratory and interfering with tests. A well-insulated sliding door of steel and concrete will separate the sound laboratory from the outside world as well as from the indoor test center itself.

The soundproof room will be large enough to test transformers weighing up to 400 tons and rated at greater than 500,000 kva, much more powerful and larger than any transformers now being manufactured. These sound tests assure that the powerful transformers will operate as silently as possible.

In the test area outside the sound laboratory itself will be conducted a variety of high-voltage tests aimed at determining the performance of the powerful transformers. Here a lightning current generator and three surge voltage generators will be installed.

Other equipment in the test area will include a 1,000,000-volt 60-cycle cascade transformer—actually three separate units hooked up in series to feed power to transformers under test. Chief advantage of this equipment is its flexibility. It can be used either as one powerful unit or to test simultaneously three smaller pieces of equipment.

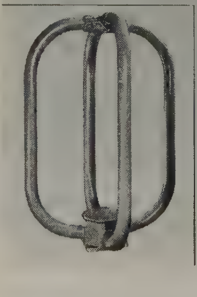
Marine Radio Direction Finder Uses Cross-Looped Antenna

A new marine radio direction finder designed to provide greater accuracy and reliability in determining a ship's position has been announced by the Marine Division of Mackay Radio and Telegraph Company.

The new direction finder perfected by Mackay engineers is designed to overcome a serious deficiency of the conventional direction finder, whose single-loop antenna is hand-rotated to obtain a bearing, and so is mounted directly above the receiver-indicator in the wheelhouse or chartroom. Although such instruments are calibrated at installation to allow for the deflection of radio waves by the surrounding superstructure, the subsequent alteration of any metallic part of that superstructure may cause appreciable error in the bearings indicated.

The new Mackay direction finder circumvents these errors at their source by making possible the location of the antenna as much as 100 feet away from the receiver-indicator, with which it is connected by coaxial cable. This is accomplished by us of a crossed-loop antenna that does not require rotation and so may be located on to of a mast or at any other unobstructed point It is the first commercial application of th crossed-loop antenna in the United States The ultracompact receiver-indicator is als designed for increased flexibility of location

The new direction finder (type *4003-A* incorporates a number of other advantages a well, including substantially improved reception. Highly selective r-f circuits and a audio filter permit radio bearings to be obtained under adverse atmospheric condition and in the presence of other radio transmissions. The entire apparatus operate directly from a vessel's 115-volt a-c suppl or from 115-volt d-c source through a smal converter, and consumes only 40 watts o power. It is available in two models, fo either binnacle or bulkhead mounting.



(Above) Bearing-indicator of new marine radio direction finder. (Left) Crossed-loop antenna can be located away from metallic obstacles

Course in Data Processing Inaugurated by Harvard

Training for a growing new field of industrial research will begin at Harvar University next fall. The work is calle "Data Processing."

It involves putting the new automati computing machinery to work on industria problems where the storage and processing o data are required.

The application of computing machiner to business and industrial use calls for me with a knowledge of engineering, electronics and mathematics as well as of their ow business procedures. Few accountants hav the necessary knowledge of technologica possibilities and few engineers have th accounting experience required.

A specialized group of graduate student will be selected for the course which leads t the degree of master of science in dat processing.

This is the first such degree offered in a American university. The beginning of th course follows by just 10 years the installation and dedication of the world's first automatic digital computer (Mark I) at Harvard This first computer, built for Harvard b International Business Machines Corporation, was dedicated on August 7, 1944 Since then the Harvard Laboratory has buil three large-scale computing machines; Mar II and Mark III were delivered to the U. S Navy, and Mark IV, an all-electronic computer, shares the Harvard Laboratory wit Mark I.

Professor Howard H. Aiken, director o Harvard Computation Laboratory, says th need for the new course has grown from a increased demand for "computing machin scientists." The course will be offere jointly by the Division of Applied Scienc and the Department of Economics with th co-operation of the Graduate School o Business Administration.

Attainment of the master's degree in th Data Processing course, will require successful completion of eight half-year courses These courses will be selected by the studen subject to faculty approval. The progra will normally cover one academic yea Provisions can be made, however, for student with insufficient preparation to take preparatory courses available at Harvard. Admission requirements call for a bachelor of science or arts degree from colleges or scientific schools of recognized standing.

Further than the academic requirements—since graduate students may have a definite field of Data Processing in mind—it is thought desirable (but not required) that the student have some business or industrial experience so that he may have some idea of the practical problems involved.

For the first year (1954–55) the time for filing applications is past. Applications for the fall term starting in 1955 should be filed with the Graduate School before May 1, 1955. Prospective students may write late in the fall of the year preceding that in which they wish to enter requesting the necessary papers and stating the subjects they wish to study.

Fast Neutron Detector Developed at Argonne National Laboratory

Until recently the only satisfactory neutron detector was the Geiger-Mueller counter tube filled with boron trifluoride, which was used for neutron detection as low as a few tenths of 1 per cent for moderate energies of neutrons and was inadequate over a large range of higher energies.

A new detector has been developed at Argonne National Laboratory which raised this efficiency detection to between 50 and 100 per cent over a wide range of energy. It consisted of the usual type of liquid scintillator containing an addition of methyl borate. Neutrons which enter the liquid are slowed down and captured by boron neuclei to produce nuclear explosions giving characteristic flashes of light that are detected by photomultiplier tubes. The sequence of events is very rapid so that the response time of this detector tends to be less than the uncertainty in the time of response of an alternative boron fluoride counter. The uncertainty results from the time taken for the neutron to traverse the counter and the uncertainty as to where it will interact in the counter tube. These counters are very sensitive to gamma rays and cannot be used where such gamma radiation is present.

AEC Selects West Coast Industrial Information Center

Stanford Research Institute, Menlo Park, Calif., has been selected as an Atomic Energy Industrial Information Depository to serve the West Coast area, the Atomic Energy Commission (AEC) announced recently.

Stanford Research is the third such depository named by the AEC. Others are the Atomic Industrial Forum, New York, N.Y., and the John Crerar Library, Chicago, Ill.

Each of the libraries designated as an AEC Industrial Depository receives as an initial complement of material some 700 reports of industrial interest selected from 9,500 "basic science" reports, drawings for the "Swimming Pool" reactor, Nuclear Science Abstracts, and bibliographies of selected AEC reports of interest to industry. New AEC unclassified reports of special interest to industry and additional engineering drawings are supplied as they become available. In return, organizations designated as AEC depositories agree to allow general access to the AEC reports collection, to provide adequate reference service to the reports, and to provide photocopies or other suitable single copies to requestors in accordance with established prices for such services.

Recipients of ASEE Awards

Recipients of the two highest American Society for Engineering Education (ASEE) Awards pose at the annual banquet at the society's 62d annual meeting. Left to right are Major Lenox Lohr, president Museum of Science and Industry, Chicago, Ill., speaker for the occasion; President Lloyd Morey, University of Illinois; Dr. T. J. Higgins, Westinghouse Award winner; Dean L. E. Grinter, retiring president of ASEE; Dean Thorndike Saville, recipient of Lamme Medal; Dean W. L. Everitt, University of Illinois

Stable Isotopes Available for Foreign Distribution

Stable isotopes produced in facilities of the U.S. Atomic Energy Commission (AEC) will be available for foreign distribution under a program announced recently by the Commission.

Radioisotopes have been sold to foreign users by the Commission since 1947, but stable isotopes generally have been available only to users within the United States. About 175 stable isotopes of nearly 50 elements are produced by the AEC. Stable isotopes, like radioisotopes, are valuable tools for basic research in various scientific fields.

A total of 48 foreign countries has been authorized to receive radioisotopes produced in the United States, and approximately 2,500 foreign shipments of radioisotopes have been made. Foreign requests for stable isotopes will be forwarded to the Commission through the official representatives of foreign nations for radioisotope procurement.

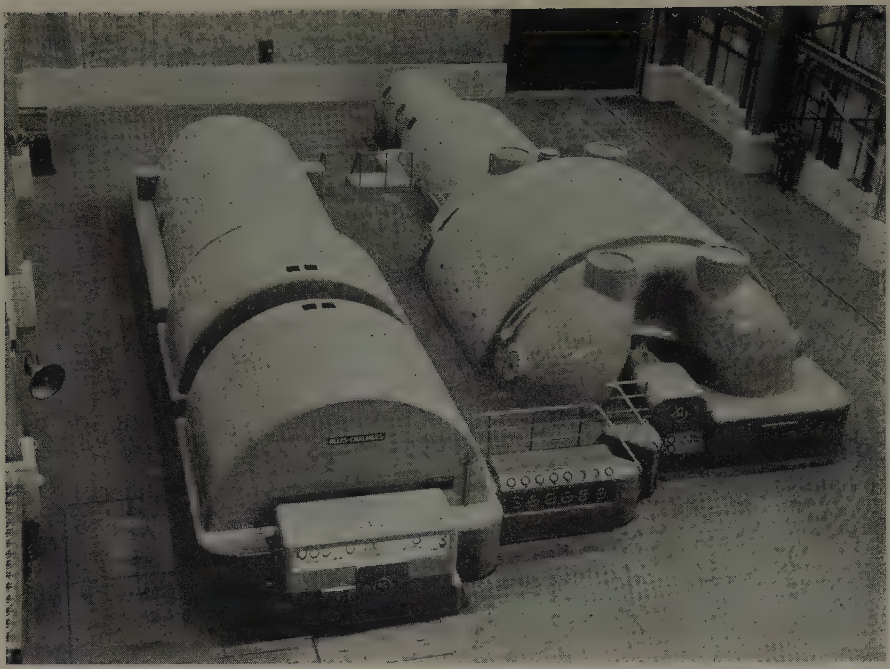
The terms and conditions for obtaining stable isotopes will be the same as those which now apply to foreign requests for radioisotopes. The applicant must agree to use the isotope only for the purpose stated in the application, and also must agree to report research results to the AEC. Foreign countries may obtain isotopes for scientific research, medical research, industrial research, medical therapy, and industrial utilization.

Stable isotopes will be sold at prices which will recover full costs of production. The quantity of a stable isotope approved for export will be limited to the amount generally provided to a domestic user for a similar purpose.

Although some stable isotopes have been produced since the 1930's, pre-World War II techniques for the concentration and separation of stable isotopes were impracticable for most elements, and only very minute quantities of pure separated isotopes could be obtained.

Electromagnetic separation was one of the methods used during World War II to separate the Uranium 235 isotope needed for atomic weapons from the more common Uranium 238 isotope. This method no longer is used for uranium separation. However, part of the electromagnetic separation plant at the Oak Ridge National Laboratory has been utilized for the production of stable isotopes for research in

Cross-Compound Turbogenerator



Shown above is the close-coupled cross-compound reheat steam turbine-generator unit 1 in the new Oak Creek Station of the Wisconsin Electric Power Company in which the Allis-Chalmers steam turbine spindle with 40-inch exhaust blades, shown on the cover of the July 1954 issue of ELECTRICAL ENGINEERING, has been operating since late 1953. This was the first 1,800-rpm unit in the world to operate with such long exhaust blades and is the first cross-compound turbine in the world to use close-coupled design. Close-coupled design makes possible the compact cross-compound unit shown in which 3,600-rpm shaft (left) and 1,800-rpm shaft are located close together. A short "cross-under" carries steam from the intermediate pressure turbine to the center of the double-flow low-pressure 1,800-rpm turbine. The entire 120,000-kw unit rests on a single foundation.

At Oak Creek, the 40-inch blades exhaust to 1/2-inch mercury pressure, the world's lowest operating exhaust pressure. An outstanding feature of the close-coupled unit is operation of both high- and intermediate-pressure turbines at 3,600-rpm keeping these high-temperature turbines of small physical size. Primary steam to the high-pressure turbine is at 1,000 F and reheat steam to the intermediate-pressure turbine is also at 1,000 F

---

quantities much greater than were available before. Most stable isotopes now are produced by electromagnetic separation.

Stable isotopes have various research uses. Some elements do not have radioisotopes with half-lives long enough to make their use feasible in experiments. Stable isotopes of these elements can be used in tracer experiments. Boron 10 is useful as a neutron detector. Deuterium, the stable heavy isotope of hydrogen, has been utilized in biological and chemical studies. Helium 3 is important in low-temperature studies.

National Science Foundation Launches Personnel Register

With the award of two grants for registration of chemists and engineers in the United States, the National Science Foundation has launched its program to establish a National Register of Scientific and Technical Personnel.

The registration of engineers will be conducted by Engineers Joint Council (EJC). At present no attempt will be made to obtain registration information on all of the estimated 500,000 engineers in the United States. The engineering section of the Register will be limited to about 20,000 leaders in all engineering fields. This selection will be based on "Who's Who in Engineering" and other sources. Experience during World War II indicates that such a list of leaders may provide an effective means for locating engineers for special projects. The engineers' list will be maintained on a current basis by EJC.

Registration of chemists will be undertaken by the American Chemical Society. The society will send out registration questionnaires to an initial list of 50,000 American chemists. In all, it is expected that information will be obtained from approximately 65,000 chemists. Registration information on each individual will include name, address, education, chemical specialty, and current employment. Information will be kept current by the society. Duplicate copies of the information will be made available to the Foundation for statistical studies and to assist in the mobilization o scientists in time of war. The informatio will not be used normally for employment o placement of scientists.

At the present time ten professiona societies or associations are collecting registration information for the Register. The lis of institutions and the estimated number o registrants to be gathered by each is a follows: American Institute of Biologica Sciences, 40,000; Federation of America Societies for Experimental Biology, 10,000 American Veterinary Medical Association 14,000; American Geological Institute 18,000; American Psychological Association, 11,000; American Institute of Physics 15,000; American Meteorological Society 10,000; American Mathematical Society 12,000; American Chemical Society, 65,000 and EJC, 20,000.

Nuclear Engineering Education Discussed at Columbia Conferenc

The training of nuclear engineers was th subject of a 3-day conference held recentl at Columbia University, New York, N. Y Scientists and educators from government industry, and universities met in a "Close Conference on Nuclear Physics in Engineering Education," sponsored jointly b the American Society for Engineering Education, the American Institute of Physics the National Science Foundation, Northwestern University, and Columbia University.

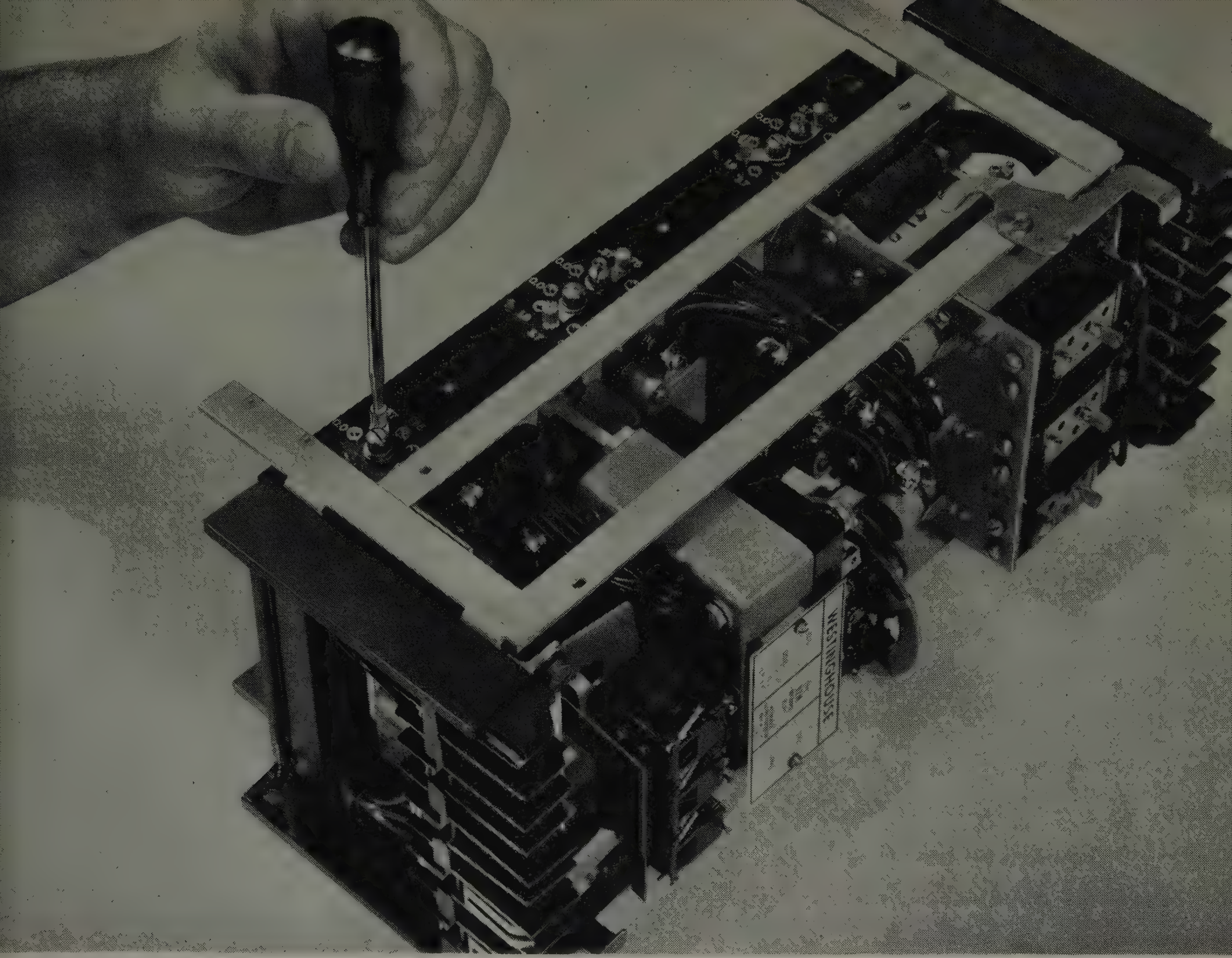
The major conclusions reached were tha (*1*) the majority of engineers employed i the nuclear field do not require a detaile knowledge of nuclear science, but must hav a qualitative knowledge of it; (*2*) wid specialization in nuclear engineering problems as another major engineering disciplin is not warranted at the undergraduate level and (*3*) the most important qualities for an engineer in the nuclear field to have are th ability to think analytically and creatively since technology in this field is diverse an rapidly becomes obsolescent.

Stone & Webster to Construct Facilities for Synchrotron

Brookhaven National Laboratory ha announced the selection of the Stone an Webster Engineering Corporation as architect-engineer of the building and supportin facilities for the 25-billion-electron-volt proton synchrotron to be built at the Laborator site at Upton, N.Y.

Approval to design the ultrahigh-energ particle accelerator was given to Brookhaven by the Atomic Energy Commissio in January 1954.

The synchrotron will be housed in doughnut-shaped tunnel approximately 2 feet in cross section. The hole in th middle will be over 800 feet across. B utilizing the new strong focusing principl and providing protons with energies as hig as 25 billion electron volts, the Brookhave alternating gradient synchrotron is expecte to contribute important new knowledge the fundamental nature of matter.



New built-in impedance modifier in Westinghouse relay saves switchboard space

The Westinghouse HZM Distance Relay now has a *built-in* network for offsetting the impedance circle. Previously, this unit was housed in a separate auxiliary box which had to be mounted on the rear of the switchboard. Mounting the impedance modifiers within the relay case provides a compact, self-contained unit which saves switchboard space. An additional advantage is the saving of wiring formerly required between relays and the auxiliary. It is also easier to test the improved relay both in the laboratory and in the field.

Adjustable Impedance—The network for offsetting the impedance circle used in the HZM Relay is particularly valuable on long lines or heavily loaded lines. The HZM can be set to include minimum fault ohms but to exclude maximum load ohms. This discrimination is possible because of the difference in phase angle between the two, even though the magnitude of the fault ohms is equal to, or less than, the magnitude of the load ohms.

Westinghouse also makes the HZ-4 Relay in which the first two impedance elements are not offset, while the third element is offset, as in the HZM. This unit is ideal for use when the first two elements serve shorter lines.

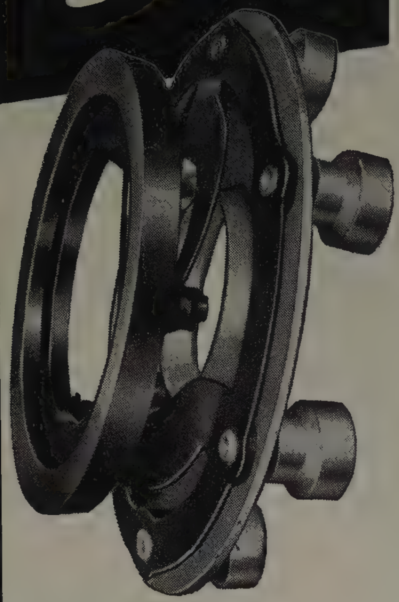
Out of the Westinghouse Relay Laboratory in Newark, N.J., has come, through the years, a constant parade of relay "firsts". For the finest relay engineering, the very latest relay developments, look to Westinghouse.

For more information on the HZM or HZ-4 Relays, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40456

YOU CAN BE **SURE**... IF IT'S

Westinghouse

Syncro-Snap

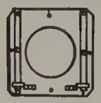


SNAP ACTION
CENTRIFUGAL
SWITCHES
can be used for:

- Single phase motors.
- Compressor unloaders.
- Gasoline engine speed control.
- Limit and sequence control for over and under speeds.
- Centrifugal actuator for mechanical and electrical devices utilizing rotary motion.

Accurately produced to your specifications, Syncro-Snap switches feature absolutely uniform operating characteristics . . . cut-out/cut-in speeds are held to any desired tolerance . . . non-fluttering, instant switching action is completed within 3 revolutions . . . action is determined by speed alone independently of voltage or load . . . unit employs only one moving part . . . and Syncro-Snap switches withstand millions of operations in actual use. Send your requirements or problems today! Standard samples available on letterhead request.

Centrifugal Switches



Stationary Switches

Dust-proof Switches

TORQ
ENGINEERED PRODUCTS, INC.
BEDFORD, OHIO

INDUSTRIAL NOTES ....

General Electric News. Arthur C. Barr, illuminating engineer at Nela Park, Cleveland, Ohio, has been appointed manager of quantity consumer sales for the company's Lamp Division.

Four appointments in the laminated and insulating products department, Coshocton, Ohio, have been made. Arthur J. Sherburne has been named manager of technical service; Richard T. Walsh, supervisor of molded laminated; Ronald W. Staley, supervisor of insulating product engineering; and Carl A. Drake, superintendent of the Coshocton plant.

RCA Changes. Appointment of John L. Franke as chief engineer, engineering department, of the RCA Victor Radio and Victrola Division, has been announced. At the same time, Alexander D. Burt was named manager of record changer engineering, and Paul R. Bennett was appointed manager of radio and phonograph engineering, both reporting to Mr. Franke.

Ford Instrument Notes. Kenneth Slawson has been named vice-president of the Ford Instrument Company Division by action of the board of directors of the Sperry Corporation. He will continue to assist the president and general manager.

A. L. Coulson has been appointed assistant sales manager of the company, a Division of The Sperry Corporation.

Appointed as manager, Army contracts, is W. F. Weber.

William V. Warner has been appointed manager, Air Force contracts.

James R. Coleman has been named manager, commercial contracts.

J. A. Barrett has been appointed manager, component contracts, handling all sales, negotiations, and contracts on components.

New Sylvania Plant. Sylvania Electric Products Inc., dedicated its new 422,000-square-foot Batavia, N. Y., television-set assembly plant recently. Situated on a 124-acre tract, the Batavia plant was designed to permit ready expansion of the existing facility, when required. Many unique features of the manufacturing and storage areas were designed by engineers of the Radio and Television Division, including a number of conveyor systems that have been described as completely new in industry.

Industrial Sales Manager Named. International Resistance Company, Philadelphia, Pa., has announced the appointment of Darrell V. Jarvis as industrial sales engineer for its Chicago branch office. He will cover northern Illinois and southern Wisconsin industrial, radio, and television manufacturers.

Sodium-Graphite Reactor Experiment. The first sodium-graphite reactor in the United States will be developed and constructed in a project sponsored jointly by the Atomic Energy Commission and North American Aviation, Inc. The project, a new step toward the development of economic nuclear power, will cost about $10 million. The reactor will be an experimental model of a full-scale power reactor already in the preliminary design stage. It will use metallic fuel elements of either slightly enriched uranium or a combination of thorium and Uranium 233. It is expected to be in operation by the middle of 1957.

Ladd Appointed Manager. Dwight H. Ladd has been appointed manager of the Dallas, Tex., plant of Federal Electric Products Company and its subsidiary, Pacific Electric Manufacturing Corporation.

Product Planning Manager Named. W. D. Pierson, Jr., has joined the marketing department of the Roller-Smith Corporation. His position will be that of manager, product planning.

Honeywell Appointment. R. B. Grant has been appointed Los Angeles, Calif., branch manager for Minneapolis-Honeywell Regulator Company. Since 1949, he has been regional industrial manager for the Pacific region.

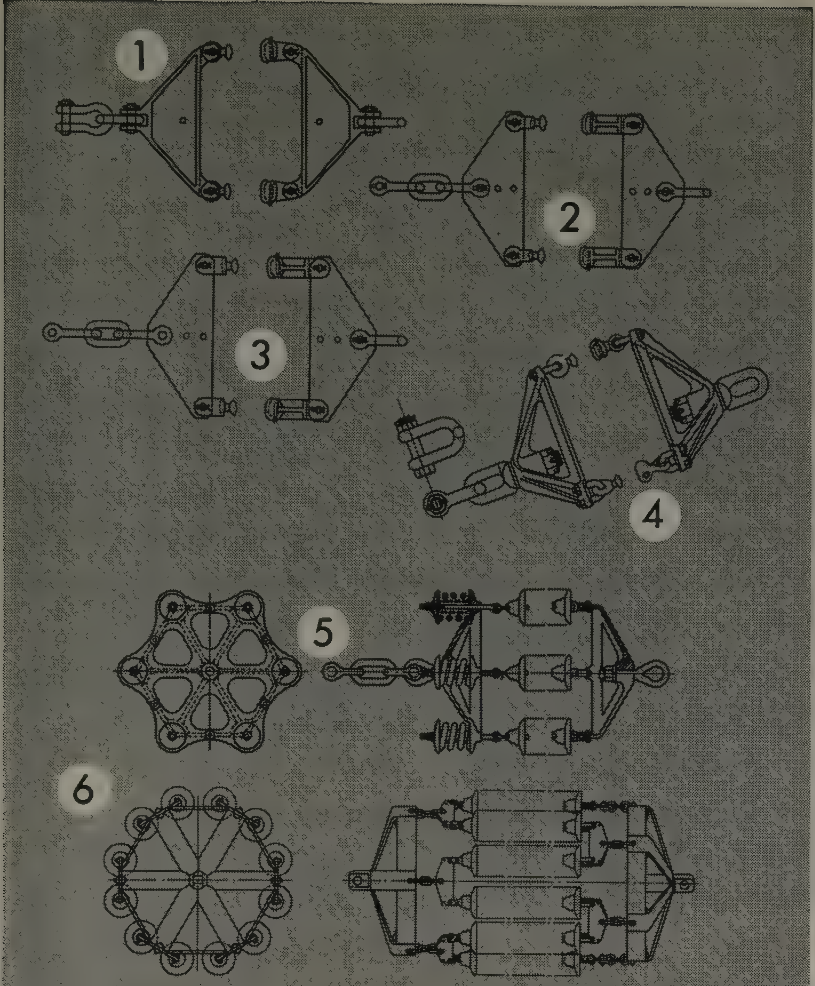
W. N. Matthews Change. As of April 1, 1954, W. N. Matthews Corporation sold their assets to the A.B. Chance Company of Centralia, Mo. Headquarters of A. B. Chance Company are located at 3850 Delor Street, St. Louis 16, Mo.

NEW PRODUCTS ..

RCA Electron Tubes. Seven new types of RCA electron receiving tubes which operate with their heaters connected in a single, simple "series string" electric circuit have been made available. The tubes operate without a heater transformer, and directly across the power-line supply. In conventional tube arrangement, heaters are connected in parallel and require a power-supplying transformer. The seven types are designated as RCA- *3BC5*, *3CB6*, *5AN8*, *5AT8*, *5J6*, *5U8*, and *12L6-GT*.

Mercury Vapor Lamp. A new 250-watt color-corrected mercury vapor lamp designed principally for installations where lamps must be mounted at heights under 20 feet has been announced by the Lighting Division of Sylvania Electric Products, Inc. Developed in the company's lighting laboratories and catalogued the *CC-H5*,

(*Continued on page 24A*)



LET'S TEAM UP ON YOUR YOKE!

① Light Duty Malleable Iron Double Strain Yoke

② Medium Duty Steel Double Strain Yoke

③ Heavy Duty Steel Double Strain Yoke

④ Triple-string Yoke

⑤ Six-string, Spring-equalized Yoke

⑥ Twelve-string, Lever Load-dividing Yoke

Working together, we can solve your problems in dead-end construction for extra-heavy-duty spans. The job doesn't come up often, and so most power companies don't have a great deal of past experience to draw upon to get it done. Our Ohio Brass engineers do have that sort of experience. Being manufacturers of suspension insulators, we have just naturally been drawn into innumerable high-strength dead-end jobs, and the experience we've gained is at your disposal.

As a result of much work with this sort of dead-end, O-B has been able to prepare several standard sets of hardware to meet most multiple-string dead-end applications. More frequently, however, those using more than six strings of insulators require special engineering treatment. In cases like this, O-B is well prepared to work once again at a now (to us) familiar job.

Let's team up on it when, if ever, you need an unusual yoke design!

Ohio Brass

MANSFIELD OHIO, U.S.A.

IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

4436-H

NOW

Precision Attenuation to 3000 mc!

TURRET ATTENUATOR featuring "PULL-TURN-PUSH" action

FREQUENCY RANGE:
dc to 3000 mc.
CHARACTERISTIC IMPEDANCE:
50 ohms
CONNECTORS:
Type "N" Coaxial female fittings each end
AVAILABLE ATTENUATION:
Any value from .1 db to 60 db
VSWR:
<1.2, dc to 3000 mc., for all values from 10 to 60 db
<1.5, dc to 3000 mc., for values from .1 to 9 db
ACCURACY:
±0.5 db
POWER RATING:
One watt sine wave power dissipation

Send for free bulletin entitled "Measurement of RF Attenuation"

•

Inquiries invited concerning pads or turrets with different connector styles

STODDART AIRCRAFT RADIO Co., Inc.
6644-B Santa Monica Blvd., Hollywood 38, California • Hollywood 4-9294

(*Continued from page 18A*)

this marks the first time a color-corrected mercury vapor lamp of medium wattage has been available in the United States. Color correction is achieved by coating the interior of the outer globe with a special phosphor which emits red light under the action of ultraviolet rays from the arc, which is enclosed in a quartz tube. The red, added to the intense blue-green of the mercury vapor arc, results in a golden white light.

Minature Magnetic Clutches and Brakes. A new line of magnetic clutching and braking devices has been developed by the Ford Instrument Company, Division of The Sperry Corporation, for applications in computers and mechanisms that require a high order of clutching and braking accuracy. With the incorporation of a telephone-type relay, maximum response time is 6 milliseconds or less; without a relay, response time is slightly higher. The unit is designed for a maximum torque of 16 oz-in., and for intermittent duty at speeds to 1,000 rpm.

Control Center Features Flexibility. Flexibility is the outstanding feature of a newly designed control center recently announced by the Square D Company. A removable operator's panel in the door of each individual combination plug-in unit accommodates up to four push buttons, selector switches, or pilot lights. This unique construction facilitates the removal of control center units since no wires to pilot devices in the door need be disconnected. For further information write the Square D Company, 4041 North Richards Street, Milwaukee 12, Wis. Request Control Center Manual *SM 244.*

Distribution Posts. Lapp Insulator Company, Inc., Le Roy, N. Y., has announced new distribution posts in two sizes, one rated at 27 kv and the other rated at 20 kv. These are solid vacuum process porcelain posts cemented into galvanized steel bases which take standard line post studs. They present the same general appearance and offer the same operating superiority as has been achieved on higher voltage posts. The larger insulator is intended particularly for use on 14.4/24.9-kv circuits. The smaller one provides extra-factor-of-safety-insulation for lower-voltage distribution and farm lines. Write for complete descriptive information with drawings and technical data.

Electronic Frequency Recorder Introduced. An electronic frequency recorder, incorporating faster response, increased accuracy, and extension of linearity over a wider range than that found in conventional instruments, has been developed for power generating plants. The single-record instrument continuously measures and records, and indicates such changes as those caused by variation in the load on electric power generating systems. These data are, in turn, utilized to regulate power generation. The new instrument has an

(*Continued on page 28A*)

ELECTRONIC TEST INSTRUMENTS

-hp- 522B Electronic Counter

IS YOUR MEASURING PROBLEM HERE?

FREQUENCY	TIME INTERVAL
Production quantities	Elapsed time between impulses
Nuclear radiations	Pulse lengths
R.P.S. and R.P.M.	Camera shutter speed
Power line frequencies	Projectile velocity
Very low frequencies	Relay operating times
Frequency stability	Precise event timing
Oscillator calibration	Interval stability
Pulse repetition rates	Frequency rates
Weight, pressure, temperature, acceleration	Phase delay

Investigate this new, low-cost all purpose *-hp-* counter

This new electronic counter can save you time and money by speeding and simplifying research and manufacturing measurements. It is a compact, low-cost, extremely versatile instrument offering you accurate frequency, period *or* time measurements. It performs all functions without extra-cost modification. Results are displayed instantly and automatically in direct-reading form. Unskilled personnel can use the instrument immediately without training.

Model 522B measures rate of occurrences from .00001 to 100,000 per second. It measures time from 10 microseconds to 27.8 hours. Counting is available over periods of 1/1,000, 1/100, 1/10, 1 and 10 seconds or multiples. Stability of time base is 5 parts per million. Time of display can be varied to any duration, counts are automatically reset, action is repetitive. Results are presented direct in cps, kc, seconds or milliseconds. Decimal point is automatically indicated.

The instrument consists of five decade counters, a wide range time base plus gating and auxiliary circuits. The unknown is applied to the counters through the gate circuit. For frequency measurement this circuit remains open for a precise interval controlled by an oven-housed quartz crystal.

-hp- 522A Electronic Counter

For applications where wide-range frequency and period measurements are desired. Frequency counting facilities are identical with 522B, except gate time for frequency measurement is 1 second or multiples, and standard frequency counted for period measurement is 100 kc. Decimal point and time interval measuring circuits are omitted. $775.00

Data subject to change without notice. Prices f. o. b. factory

SPECIFICATIONS—MODEL 522B

FREQUENCY MEASUREMENTS:

Range: 10 cps to 100 kc.

Accuracy: ± 1 count ± stability (5/1,000,000 per week).

Registration: 5 places. Output pulse available to actuate trigger circuit for mechanical register to increase count capacity.

Gate Time: .001, .01, .1, 1, 10 seconds. Extendable to multiples of 1 or 10 seconds by manual control.

Display Time: Variable .1 to 10 seconds in steps of gate time selected. Display can be held indefinitely.

PERIOD MEASUREMENTS:

Range: .00001 cps to 10 kc.

Accuracy: ± .03% ± stability (for measurements over a 10 cycle period).

Gate Time: 1 or 10 cycle of unknown. Extendable to any number of cycles by manual control. (For frequencies under 50 to 60 cps.)

Standard Freq. Counted: 1, 10, 100 cps; 1, 10, 100 kc; or external.

TIME INTERVAL MEASUREMENTS:

Range: 10 μsec to 100,000 seconds (27.8 hrs.)

Accuracy: ± 1/std. freq. counted ± stability.

Trigger Slope: Pos. or neg. on start and/or stop channels.

Trigger Amplitude: Continuously adjustable on both channels from −100 to +100 volts.

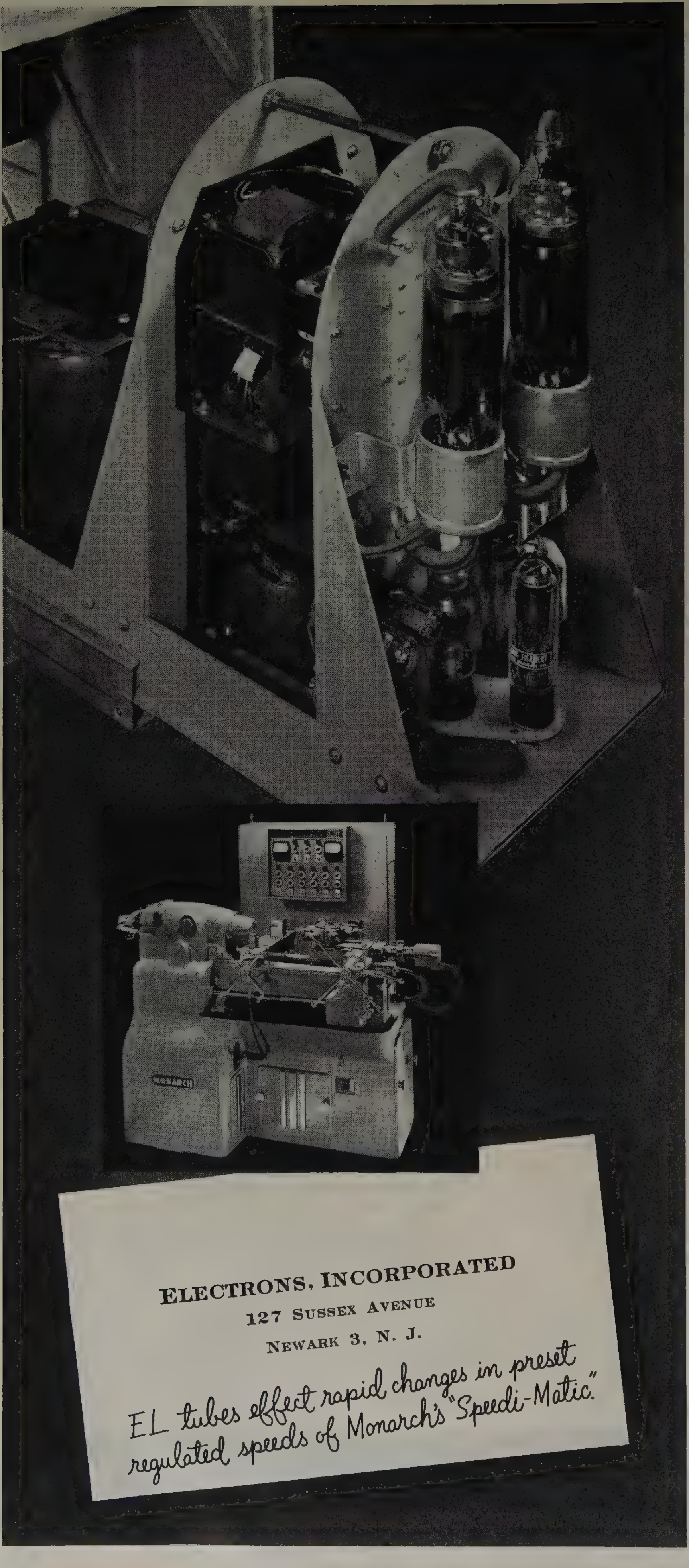
Standard Freq. Counted: 1, 10, 100 cps; 1, 10, 100 kc; or external.

Price: $900.00 f.o.b. factory.

Write for complete details

HEWLETT-PACKARD COMPANY
2707E PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
SALES REPRESENTATIVES IN ALL PRINCIPAL AREAS
Export Division: 275 Page Mill Rd., Palo Alto, Calif.
Cable "HEWPACK"

Instruments for Complete Coverage



ELECTRONS, INCORPORATED
127 SUSSEX AVENUE
NEWARK 3, N. J.

EL tubes effect rapid changes in preset regulated speeds of Monarch's "Speedi-Matic."
MONARCH

(*Continued from page 24A*)

accuracy of 0.01 cycle per second and will respond to frequency changes as small as 0.005 cycle per second. For further data ask for Data Sheet Number *9.1-8A*, Minneapolis-Honeywell Regulator Company, Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Reversing Drum Switch. Federal Electric Products Company, 50 Paris Street, Newark, N. J., is now producing a new reversing drum switch for all ratings up to 2 hp. This Bulletin *905* reversing drum switch is suitable for use with many types of electrically driven equipment including conveyors, hoists, wood and metal working machinery, machine tools, pumps, and processing equipment.

Heating Unit. McCreary Machine Works, Cohoes, N. Y., in co-operation with the General Electric Company, has developed a novel heating unit which offers remarkable temperature range and very close heat control tolerances. These units are ideally suited for the application of intense heat to production products on a moving conveyor. The units are composed of G-E Calrod (registered trade-mark) heaters with a temperature range to 1,500 F. Temperature is controlled by the G-E Reactrol (registered trade-mark) system which varies the power applied to the heaters in accordance with the predetermined need.

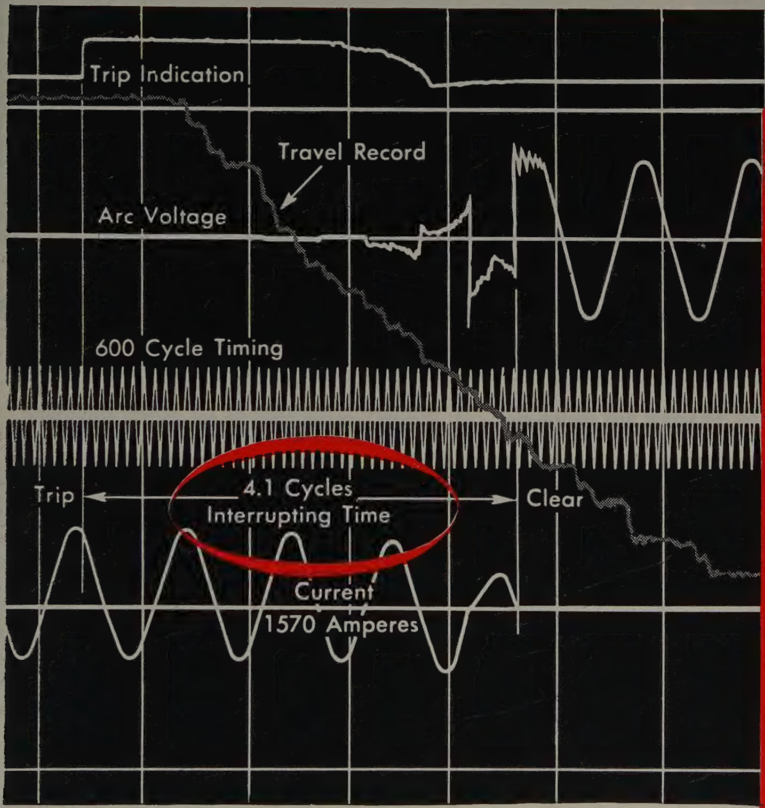
Connector Cables. A new cabling technique has been developed, making it possible to mold several cable connector components into one integral unit by molding the connectors right onto the wire insulation. The high-voltage potential sources are sealed into the insulating jacket greatly reducing the problems of corona suppression and shielding. Only the female contacts are exposed to the air and only at the point of mating where there is a natural damping of corona. Developed for color television, these integrally molded cables have a wide field of application in other areas: high-voltage power supplies, high-voltage rectifier circuits in such equipment as radar, transmitters, X ray, and many others. For additional information or specification sheets, contact: Nelson W. Hearn, Department 16, Alden Products Company, Brockton, Mass.

Transistors. Faster and more accurate testing of transistors has been made possible by a new instrument developed at Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill. The instrument, called the transistor analyzer, is used to measure directly the circuit constants of transistors while they are in operation. The analyzer is small, lightweight, and portable and can be used to test any type of junction transistor at low frequencies. Transistor operation is generally described in terms of small-signal T-equivalent-circuit parameters which are the basis for circuit analysis and design. The analyzer is unique because it makes direct measure-

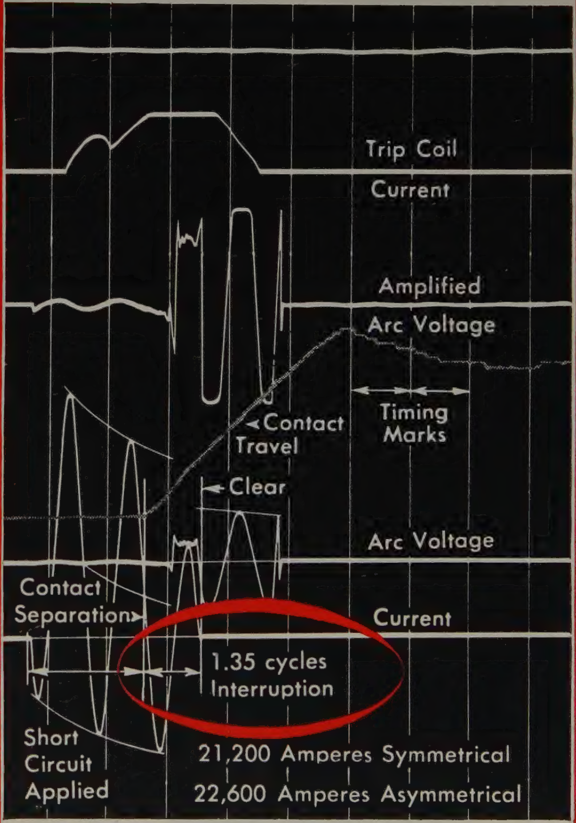
(*Continued on page 42A*)

Proof OF FAST INTERRUPTION

BREAKER for CLAD SWITCHGEAR



FAST INTERRUPTION AT 500,000 KVA



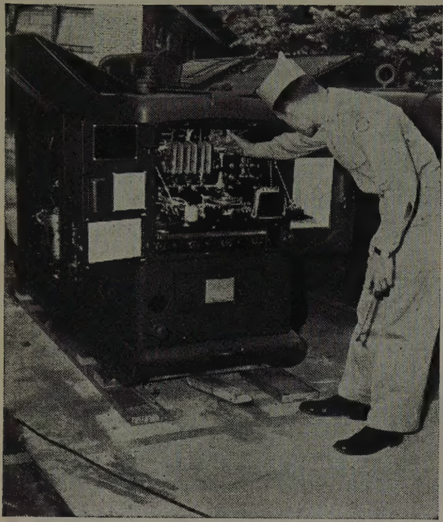
AND FAST ON HIGH CURRENTS TOO!

New breaker also has high speed 4-bar mechanism··· "blow-on" contacts··· and sectionalized arc chute assembly that can be lifted off by one man.

CHALMERS

A-C
ALLIS CHALMERS

Ground-testing electronic equipment keeps 'em safe in the sky



To insure reliable flight performance, electronic equipment—radio, radar and navigational devices—is tested on the ground with power supplied by Regohm-controlled generators.

Engineers of The Hobart Brothers Company, Troy, Ohio, use Regohm regulators for their alternating current ground units. Because this low-cost, compact electro-mechanical controller is unequalled in accuracy. And under severe operating conditions, whether on land, sea or air, Regohm has performed long and unfailingly.

7 Reasons why Regohm can simplify your control problem

1. Regohm is small in size—It is compact, lightweight, position-free. Small size does not limit power-handling capacity.

2. Regohm is a high-gain power amplifier—Milliwatt variations in signal energy control energy changes millions of times greater.

3. Regohm's isolated signal and control circuits end impedance matching problems—Signal coils may have ratings from 0.01 to 350 amperes. Controlled resistors can have values from zero to infinity.

4. Regohm will correct system instability—A reliable, sturdy dashpot aids system damping. It's easily adjusted over a wide range to match dynamic Regohm characteristics to present system.

5. Regohm's effect can be calculated in advance—Its response is independent of rest of servo system. Acts as integrating error-rate proportional controller.

6. Regohm assures continuous control—In "closed loop" systems a high speed averaging effect occurs as Regohm's armature oscillates over a small amplitude. This provides continuous, stepless control in systems operating at power frequencies and below.

7. Regohm has long life—Its life is measured in years. Its plug-in feature simplifies replacement and maintenance; there are no parts to renew or lubricate. Shelf life is virtually unlimited.

Our engineering and research facilities can help you apply Regohm to your control system or regulation problem. Write for Bulletin 505.00, analyzing Regohm's characteristics and applications. Address Dept. EN., Electric Regulator Corp., Norwalk, Conn.

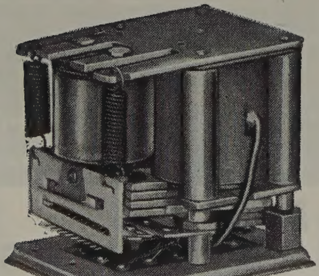
Ground Power Supplied

by Hobart electric generators

Controlled

by Regohm

Voltage Regulators



REGOHM

CONTROL COMPONENT IN: Servo systems • battery chargers • airborne controls • portable and stationary generators • marine radar • inverters • locomotive braking systems • mobile telephones • guided missiles • signal and alarm systems • telephone central station equipment • magnetic clutches • railroad communication systems • magnet amplifiers.

(Continued from page 28A)

ments of these parameters. Equivalent circuit parameters provide a mathematical representation of the transistor operation, and these parameters are functions of temperature, voltages, and currents, varying with age and not being uniform for all transistors even of one type.

TRADE LITERATURE

Fluorescent Products. A new "Fluorescent Guide," written in nontechnical language for the use of both buyers and sellers of fluorescent products, has been announced by Sylvania Electric Products, Inc. It contains information on what fluorescent lighting is, its advantages, the sizes in which lamps are available, colors, necessary accessories, and many other pertinent facts. Copies of the "Fluorescent Guide" will be available through the various Sylvania district offices.

Air Control Valves. Three fundamental types of air control valves are described and illustrated in a 12-page booklet published by Ross Operating Valve Company, Department 802, 120 East Golden Gate, Detroit 3, Mich. The booklet explains the primary advantage of air power including speed, cleanliness, economy, resiliency, and lightness. The new booklet, known as Ross Bulletin *101B*, will be sent free upon request.

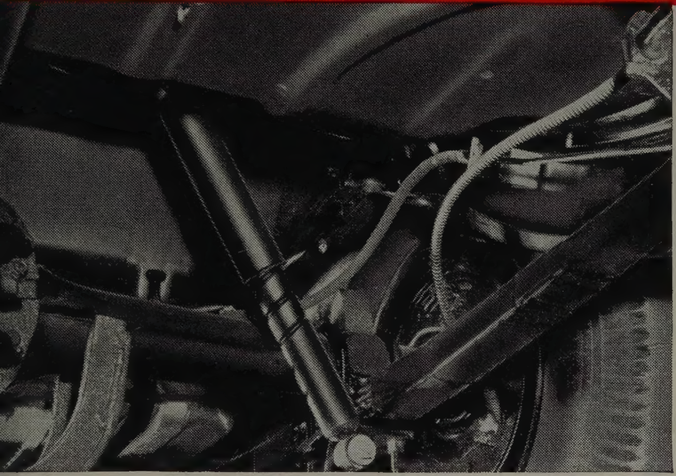
Components Parts Catalogue. Announcement was made of the publication of a new 100-page bound Component Parts Catalogue *GEC-1025*. It is designed specifically for original equipment manufacturers who incorporate electric components into their products for resale. Over 2,500 catalogue numbers are listed, and in addition this comprehensive manual includes descriptions, list prices, and dimensional outline drawings on the majority of products. Copies are available upon request from the nearest G-E Apparatus Sales District Office or from Trumbull Components Department headquarters in Plainville, Conn.

Micro Switches. A newly published Catalogue *101*, entitled "Switches for Industry," has been announced by Micro Switch, Freeport, Ill., a division of Minneapolis-Honeywell Regulator Company. This 20-page catalogue covers 22 "families" of switches, describing 258 different switches, actuators, and enclosures.

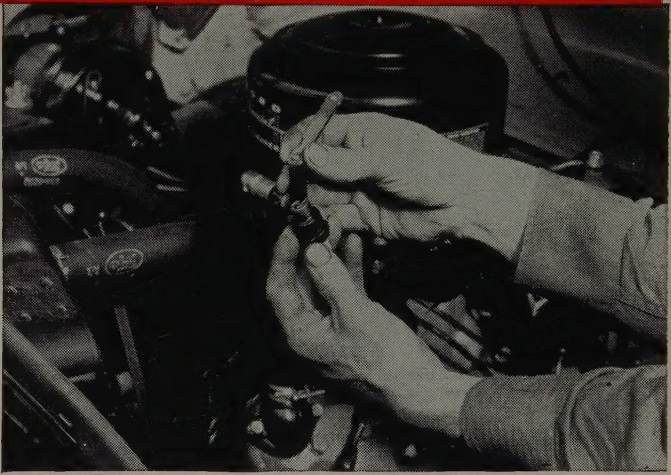
Materials for Repair and Maintenance. A 32-page catalogue that has descriptive information, photographs, prices, and ordering data on electrical insulating materials is available from Insula-

(Continued on page 54A)

high quality Amerstrip these specialty products

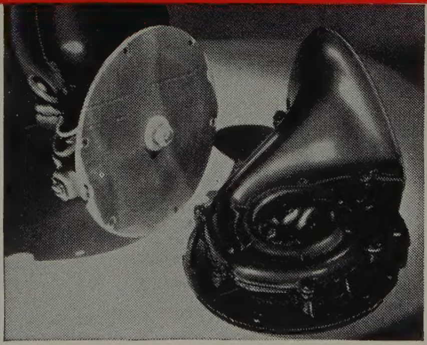


De-Jolting Mechanism. In automobile shock absorbers, discs of Amerstrip help to regulate the flow of oil to cushion bumps and jolts. Close attention is paid to temper and flatness to lengthen fatigue life.



For Measuring Thousandths. Amerstrip Feeler Gauge Steel is extremely flat, uniform, and rolled to close tolerances. It is available with a #1 edge, bright tempered, in thicknesses from .0015″ to.025″.

For Stopping Stuck Shades. High carbon Amerstrip Curtain Spring Wire assures good strong winding action on window shades, portable projection screens, schoolroom maps, and similar products. In coils, in all standard sizes.



High Honking Power. Only a flat, scaleless, tempered high carbon strip can withstand the high stresses and fatigue encountered in automobile horn diaphragms. Amerstrip Diaphragm Steel is made especially for this tough job.

Bumbershoots. Amerstrip Umbrella Wire is used in ribs and bows of umbrellas. It is straight, formable, and smooth. Special sizes of this high carbon annealed wire are stocked. Every phase of manufacture is controlled closely.

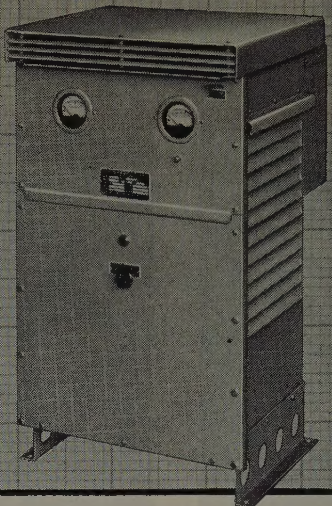
FOR MORE INFORMATION— Write your nearest American Steel & Wire sales office.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Amerstrip

CARBON • ALLOY USS TRADE MARK STAINLESS

UNITED STATES STEEL



A New Type of D-C Power Source

C&C

STAVOLT®

POWER RECTIFIERS

Closely Regulated by Magnetic Amplifier Control of unique and stable qualities.

Low Ripple

Fast Response

- Ten standard 28 Volt production models up to 1000 amperes, many others, mobile or stationary.
- Amazing size and weight reduction made possible by use of latest core and insulation materials and aluminum construction.
- Encapsulated components—shock mounted meters recessed behind plastic windows.
- No tubes—lamps—carbon piles—commutators or moving contacts and no radio interference.
- STAVOLT Rectifiers are rugged and can take heavy intermittent overloads. They meet MIL-E-7894 with both range and characteristics.

Engineers will be interested in learning more about the fine qualities of STAVOLT Rectifiers. Write for catalog with detail specifications.

McCOLPIN-CHRISTIE CORP.

3400 West 67th Street, Los Angeles 43, Calif.

25th Year of Rectifier Manufacturing

(Continued from page 42A)

tion Manufacturers Corporation. Repair shops and maintenance departments will find this catalogue a complete source for the electrical insulations they need. Copies are available without charge by writing Publications Department, Insulation Manufacturers Corporation, 565 West Washington Boulevard, Chicago 6, Ill.

Swiss Precision Fabrication. A 12-page illustrated catalogue showing Swiss automatic screw machine products made in a range from 0.5- to 25-mm diameter has been announced as available. For copies write to American Laubscher Corporation, 333 West 52d Street, New York 19, N. Y.

Environmental Testing for Proof of Design. Environmental testing is the subject of a folder made available by writing to New York Testing Laboratories, 47 West Street, New York, N. Y. Tests such as vibrations, shock, humidity, high altitude and explosion, salt spray, and sand and dust are described in this folder. Some of the environmental equipment used in making these tests are illustrated and described.

Magnetic Tape Recording. Bulletin Number *D2-7*, published by Amperex Corporation, explains the versatility of magnetic recording and attempts a thorough exposition of its properties and applications. Illustrated and containing information for a recording system that can feed information to instruments that scan, to instruments that write, to machines that translate, or to machines that act are included in this new booklet. For copies write to Charles H. Wirth, Instrumentation Sales, 405 Lexington Avenue, New York 17, N. Y.

Germanium Diode Bulletin. A new 4-page Bulletin *GD-1A*, listing ratings and specifications on International Rectifier Corporation germanium diodes, is now available on request from the manufacturer. Included in this bulletin is a complete replacement guide of International germanium diodes for replacing Radio - Electronics - Television Manufacturers Association type of diodes, and ratings and characteristics for new "Red Dot" germanium diodes for 100 C applications. Write International Rectifier Corporation, 1521 East Grand Avenue, El Segundo, Calif. for Bulletin *GD-1A*.

Signal Generators. A new vhf signal generator offering residual frequency modulation less than 1 kc, drift less than 0.005 per cent, sensitivity measurements to 0.1 microvolt, and a new high in stability is now being offered by the Hewlett-Packard Company. The new instrument, model *608D* vhf signal generator, covers the frequency range 10 to 420 mc. A directly set and read output of 0.1 microvolt to 0.5 volt is available through this range. Complete details are available from Department P, Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, Calif.